PLASTICS

JUNE 1961

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

Among the important factors in Shell Chemical's decision to make polystyrene were its extensive background in polymers and its raw material position. Two other Shell thermoplastics followed quickly—polypropylene and polyethylene.

BULLETIN:

On May 3, 1960, a remarkable thermoplastics decision was made by Shell Chemical

Read about this Shell decision. And how you can start benefiting today from a major new source of polystyrene, polypropylene and polyethylene that resulted from it.

ON MAY 3, 1960, Shell Chemical, a company long basic in styrene monomer and SBR rubber, decided to combine the two in full commercial production of Shell high impact polystyrene. Why was this remarkable?

A revealing fact on polystyrene

The condition of the polystyrene market was not attractive. There was oversupply from some of America's finest companies. The field was mature and Shell was starting late.

One revealing fact offset this situation. *Shell, with its excellent background in polymer chemistry—as exemplified by Shell Isoprene Rubber, the industry's first commercially produced synthetic/natural rubber—could make positive contributions to the thermoplastics field in the form of new products.* But Shell would be severely handicapped without a thorough understanding of how the thermoplastics market works and what it wants.

Result? Shell's decision to go full speed ahead with high quality general purpose, medium and high impact Shell polystyrenes, plus a rapidly expanding technical sales force.

80 million pounds of polypropylene

Two other thermoplastic developments followed quickly.

One, Shell's announcement in October, 1960, for an 80 million pounds a year polypropylene plant with customer service and research facilities to be built near Woodbury, N. J. Two, an arrangement by which Shell will resell limited quantities of polypropylene until this plant comes on stream.

Custom-made polyethylene

And this, in turn, led to a third important thermoplastic.

In order to round out a complete line of thermoplastics, Shell Chemical, in January, 1961, made arrangements to supply the industry with the highest quality custom-made polyethylenes.

How to start benefiting

Thus, within 8 months, Shell became an important factor in three plastics: Shell polystyrene, Shell polypropylene and Shell polyethylene.

The next 8 months should be even more important. Shell will be going full speed ahead searching for new polymers you want.

Now is the time to let Shell's technical representative know your needs. Tell him about them on his next visit or write Shell Chemical directly at:

42-76 Main St., Flushing 55, N.Y. FLushing 3-4200; 20575 Center Ridge Rd., Cleveland 16, O. EDison 3-1400; 6054 West Touhy Ave., Chicago 48, Ill. SPring 4-6711; or 10642 Downey Ave., Downey, Calif. SPruce 3-0601.

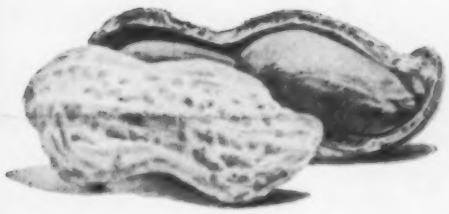
A Bulletin from

Shell Chemical Company

SHELL

Plastics and Resins Division

Nature provides safe...



...nontoxic protection...

...and so can you in...

...your packaging product.

plasticize with

PFIZER CITROFLEX® A-4

(accepted by the F.D.A.)

Be sure the plasticizer you use in food-wrap products is safe beyond all doubt. Specify Pfizer CITROFLEX A-4 (Acetyl Tributyl Citrate), the product of choice for use in plastic coatings, packaging films and plastisols. It is nontoxic, odorless, economical. It has been accepted by the Food and Drug Administration for use in the manufacture of packaging for both fatty and non-fatty food products. Look to Pfizer first for safe, economical plasticizers. Why not investigate Pfizer's complete line of nontoxic plasticizers? Write for Technical Bulletin #31, "Citroflex Plasticizers." Chas. Pfizer & Co., Inc., Chemical Div., Brooklyn 6, N. Y.

Science for the world's well-being

Pfizer

CHEMICAL DIVISION

PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

June 1961, Vol. 7, No. 6

feature articles:

New way to extend polyester pot-life ..... p. 39

by J. Kaminetsky, N. Fried and R. R. Winans

Complex reinforced plastic laminates require both a long pot-life and a short gel period—neither of which are available (in combination) with conventional peroxide curing systems. By adding such ultraviolet sensitizers as benzoin, benzil, or Garalyst, the two requirements are met. Curing can then be effected with artificial ultraviolet radiation or direct sunlight, at 0° C, or at 25° C. Physical properties compare favorably to conventionally fabricated laminates.

Pneumatic materials handling—a survey report ..... p. 47

by Jean E. Jellinek

What the plastics processor needs to know about this handling technique, including equipment, operation, and cost. Pneumatic handling can provide savings in labor, material cost, insurance, housekeeping, and other expenses.

Vary the catalyst to vary epoxies' bonding properties ..... p. 52

by Kenneth W. Carroll

Various combinations of hardeners with one epoxy adhesive gave a wide range in such properties as hot strength, peel strength, solvent resistance, and pot life. With this in mind, it may not be necessary to purchase a special type adhesive for a given application, but merely check with the adhesive supplier as to which hardener should be used.

engineering forums:

Consultant's column ..... p. 55

by Dr. S. S. Stivala

Compression & transfer molding ..... p. 56

by Paul E. Fina

Diversify to expand—here are your thermosets

exploring fabrication techniques:

Polysulfide Casting Techniques, Extruded film, thickness gaging ..... p. 58

by L. J. Zukor

feature story:

Compression molding insulates missile ..... p. 46

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Cover photo courtesy:
Aero Service Corp.

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U.S.I. POLYETHYLENE NEWS

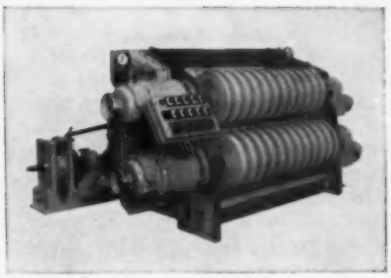
A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

JUNE, 1961 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Tamper-proof, re-sealable container for liquids, powders or pills features a unique, locked-in closure of polyethylene. A protruding knob can be "snapped off" easily with one hand—yet is completely tamper-proof before purchase and use since closure is a one-piece unit. To re-seal, user merely sets the now-separate tip into opening and presses it down until it locks in place.

High-speed slitting machine slits and rewinds polyethylene film, coated papers and other materials of uneven caliper at speeds up to 1700 ft. per min. Available in all sizes up to 64" web width for razor blade or shear cut.



New sealer-handle designed for use on polyethylene bags provides an air-tight waterproof seal, then locks to form a convenient carrying handle. Current applications include packaging fruit, produce, toys.

It's of simple, one-piece construction—just a strip of .060 inch polyethylene with a horizontal center slit and interlocking hooked ends. To apply, top of the filled bag is pulled through the slit, the sealer-handle rolled downward and the hooks joined. To open, process is reversed. Neither sealing nor re-opening damages bag.

This device, also reusable, will reportedly hold any weight the bag will support. Since two separate bags can share a common sealer-handle, it's ideal for tie-in merchandising.

Polyethylene sealer-handle attaches in 4 to 5 seconds, can be used over and over.

Magazines Now Mailed In Polyethylene Film

Tight, Handsome Machine-Wraps Protect Better, Cost Less

Hand insertion of magazines into envelopes may soon be a thing of the past. A Midwestern printer now packages publications for mailing at the rate of 1000 magazines per hour, twice the rate of the hand operation!

Photo courtesy The Wayside Press, Inc.

Publication is shown being packaged in polyethylene film. Magazines reach subscribers clean, fresh and undamaged.

He uses rolls of 1.5-mil polyethylene film printed in two colors. A Model MA packaging machine forms bags around the magazines and heat-seals them tightly against moisture and dirt.

High Acceptance

The printer reports that after the first experimental mailing of 100,000 magazines, no complaints were received from either the Post Office or from subscribers. In fact, subscribers have written to the publishers expressing enthusiasm for the improved appearance of the mailed material and the better condition of the magazines on arrival. Front and back covers are clearly displayed through the transparent film.

The success of this printer with polyethylene-packaged magazines opens up a whole new field of possibilities for the mailing of printed matter. Improvements were achieved with no increase in overall costs. The advantages of mechanization, improved appearance, colorful package printing, and protection against soiling, rough handling, tearing and weather should not be overlooked by anybody who ships extensively through the mails.

Polyethylene Helps Package Hypodermic Needles

Polyethylene plays a multiple role in a new strip package developed in England for hypodermic syringe needles. The web materials used are polyethylene coated cellulose film and a laminate of .0035 mm aluminum foil and .0015 in. polyethylene film.

Novel automatic machines form shaped depressions in the foil web to receive the needles and, after these have been hand-inserted, complete the packs with the cellulose film cover and a polyethylene-to-polyethylene heat seal.

The finished strip is scored for easy tearing between each needle packet and cut after every twelfth. As a final step the needles are sterilized by permeating the package with ethylene oxide gas.

Polyethylene's toughness, resistance to bacteria and moisture-barrier properties also get into the act—keeping the needles sterile and ready for use almost indefinitely.

Did You Miss These?

Reprints of two recently published articles on polyethylene are currently available through U.S.I.:

1. "Poly Bread Wraps: Growth Continues," 4 pages, by William U. Funk, U.S.I. Sales Engineer.
2. "The Effect of Molecular Weight Distribution on the Flow Properties of Polyethylene," an 8-page technical report of experimental work conducted at U.S.I.'s Polymer Service Laboratories.

If you missed either or both of these timely articles, or would like extras for your file, copies can be obtained by writing Technical Literature Department, U. S. Industrial Chemicals Co., 99 Park Avenue, New York 16, N. Y.

IF YOU WOULD LIKE further information on any developments reported in U.S.I. Polyethylene News, U.S.I. will be glad to send you the names of the manufacturers. U.S.I. also invites you to send information on your new developments for possible inclusion in the News.

Address:
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Letters to the Editors

Sirs:

In the April issue of your PLASTICS TECHNOLOGY we noted the table on page 67 setting forth the "Domestic Production and Sales of Plastics and Resin Material, November and December, 1960."

In the group entitled Styrene resins, you do not show any figures for the expandable polystyrene. I therefore assume that this is in one of the other categories. If this is so, will vou advise in which category it is included.

Will you also please advise if it is possible for me to obtain figures for the entire year of 1960?

Edward R. Bose
Treasurer
United Cork Cos.
Kearny, N. J.

(Figures for expandable polystyrene production and sales are included in the category "All other" under Styrene resins: molding and extrusion materials. The United States Tariff Commission, Chemical Division, which supplies these statistics, may be able to provide a more detailed breakdown. Figures for the year are published in each May issue of PLASTICS TECHNOLOGY.—Editor.)

Sirs:

Upon reviewing your January 1961 issue of PLASTICS TECHNOLOGY magazine, I was impressed by the number of responses on "Markets for Flexible Foams" in "Letters to the Editor."

We, as sellers of plastic foams for packaging, have a great interest in this commodity. I missed this particular edtiorial and it would be greatly appreciated if you could furnish either a copy or abstract of same.

Thank you for your courtesy.

N. J. Scardino
Manager — Packaging Div.
Geo. W. Millar & Co., Inc.
New York 12, N. Y.

Sirs:

Your column "Exploring Fabrication Techniques" in the November 1960 issue treated the subject of orientation of thermoplastic films and indicated that additional articles on this subject would be published. To my knowledge, only one subsequent article (January 1961) has dealt with orientation. I would be interested in knowing whether any future articles will be devoted to this subject and when they are to be published.

I should also appreciate any references you are able to provide on the subject of biaxial orientation.

J. B. Mauro
Film Operations
Olin Mathieson Chemical Corp.

(Oriented vinyl and polypropylene will be covered in future issues. The next article on oriented film will probably appear in July or August.—Ed.)

Sirs:

I refer to an article by Messrs. Frimberger and Fuller, "Single Screw Injection Molding," in your May 1961.

On page 55, the authors refer to the Jackson and Church process, and to a figure 6 showing the equipment; both the drawing and the statement that the pellets were added on top of the molten mass are incorrect. It is true that Jackson and Church was granted a patent, one of many on screw type plasticizing machines, covering this possibility; however, no machines incorporating this innovation were sold. The material was delivered to the injection chamber as a homogeneous mass.

Jackson and Church Co. pioneered screw type pre-plasticizing in this country, and as early as 1951, injection molded rigid, unplasticized PVC into pipe fittings. Since March of 1952, these machines have been in constant production of unplasticized PVC fittings and components by Tube Turns Plastics, Inc., half owned by the former owners of Jackson and Church Co. and half owned by the Chematron Corp. They have a history of nine years of steady molding operation on these high viscosity molding materials.

James W. Hendry,
Former vice pres.
Tube Turns Plastics
Jackson and Church Co.

We invite letters from our readers for publication in these columns. Such letters The only requirement is that all letters may be of comment or criticism, requests for information, or of general interest. must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

On Schedule

The big feature for July, in fact we call it a special issue, is the comparative listing of specification data on 1961 injection molding machines. The listing is annual, and carries the data which you, the readers, and authorities on injection molding feel are the pertinent features of injection machines and the ones which offer the fairest means of comparison. All material is staff compiled.

•

In addition to the tabulations, we will again run an article on some phase of injection molding—with direct reference to the equipment involved. Past subjects covered points to look for when buying the machines or auxiliary equipment, and this article will go into machine problems in more detail.

•

We have two series of articles in the planning stage. One concerns OEM equipment such as heaters, chillers, electrical connections, and the like; the other concerns pensions, profit-sharing, and other problems involved in shop management.

•

Another article on tap covers the extrusion of polypropylene filament, as recommended by the laboratories and test facilities of Eastman Chemical.

•

IF PHENOLICS CAN DO IT, PLENCO CAN PROVIDE IT—AND DOES—FOR THE HOOVER COMPANY

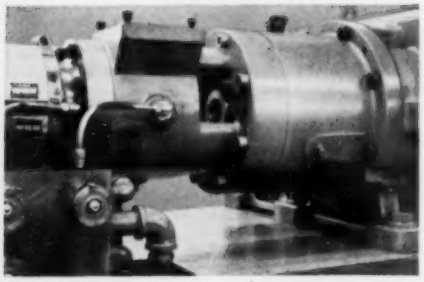
An end at last to wielding soggy mops, wringing dirty sponges, and all of the other unpleasant tasks that go with washing floors. That's what The Hoover Company of North Canton, Ohio, has done for the American housewife. Hoover's revolutionary new electric floor washer wets floors with clean water and detergent, scrubs them thoroughly, and vacuum dries them—all automatically!

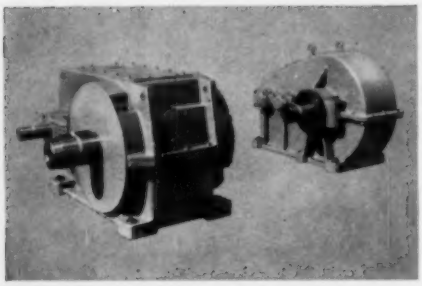
In designing this unique appliance, the close juxtaposition of water and electric motor demanded that a material with high insulating properties be used in molding end plate and fan chamber. Hoover engineers found that Plenco 507 phenolic molding compound provided the insulating qualities, moisture resistance, as well as excellent dimensional stability required.

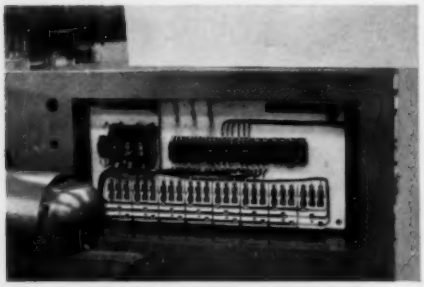
The story is the same with other leading manufacturers: an unusual product, component, or molding problem—usually answered with the help of versatile Plenco phenolics. That's true whether your specifications call for a special-purpose or general-purpose molding compound, ready-made or one that's custom-formulated. You're welcome to explore the possibilities with our technical staff at any time.

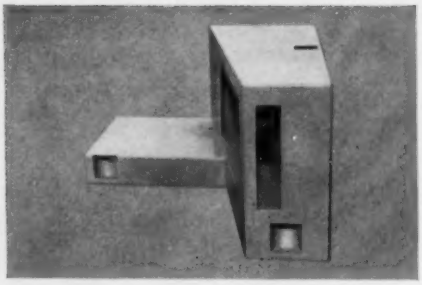
PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.



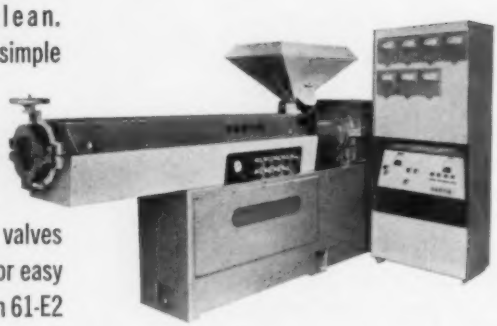






IT'S ALL NEW

HEAVIER THRUST HOUSING: room for single and double row bearings. A larger flange bolted to new gear reducer eliminates the need for additional support under the feed throat. **HEAVIER GEAR BOX,** specially designed and built to Waldron-Hartig requirements. Herringbone gear reducer housing has special large flange. Oil bath lubrication supplies oil generously to gear box and thrust bearings. Machine is **COMPLETELY PREWIRED** to allow for faster, easier installation. Safety disconnect switch is located in extruder base. Heavy wiring from control cabinet to extruder is eliminated. Hartig extruders may be installed and made ready to operate in one day. Covers are well designed, functional; easy to remove, replace, and keep clean. **TRAPEZOIDAL BASE** has simple clean functional lines for strength and easy maintenance. Partition separates blowers from electrical units. Control valves and piping are arranged for easy operation. Ask for Bulletin 61-E2

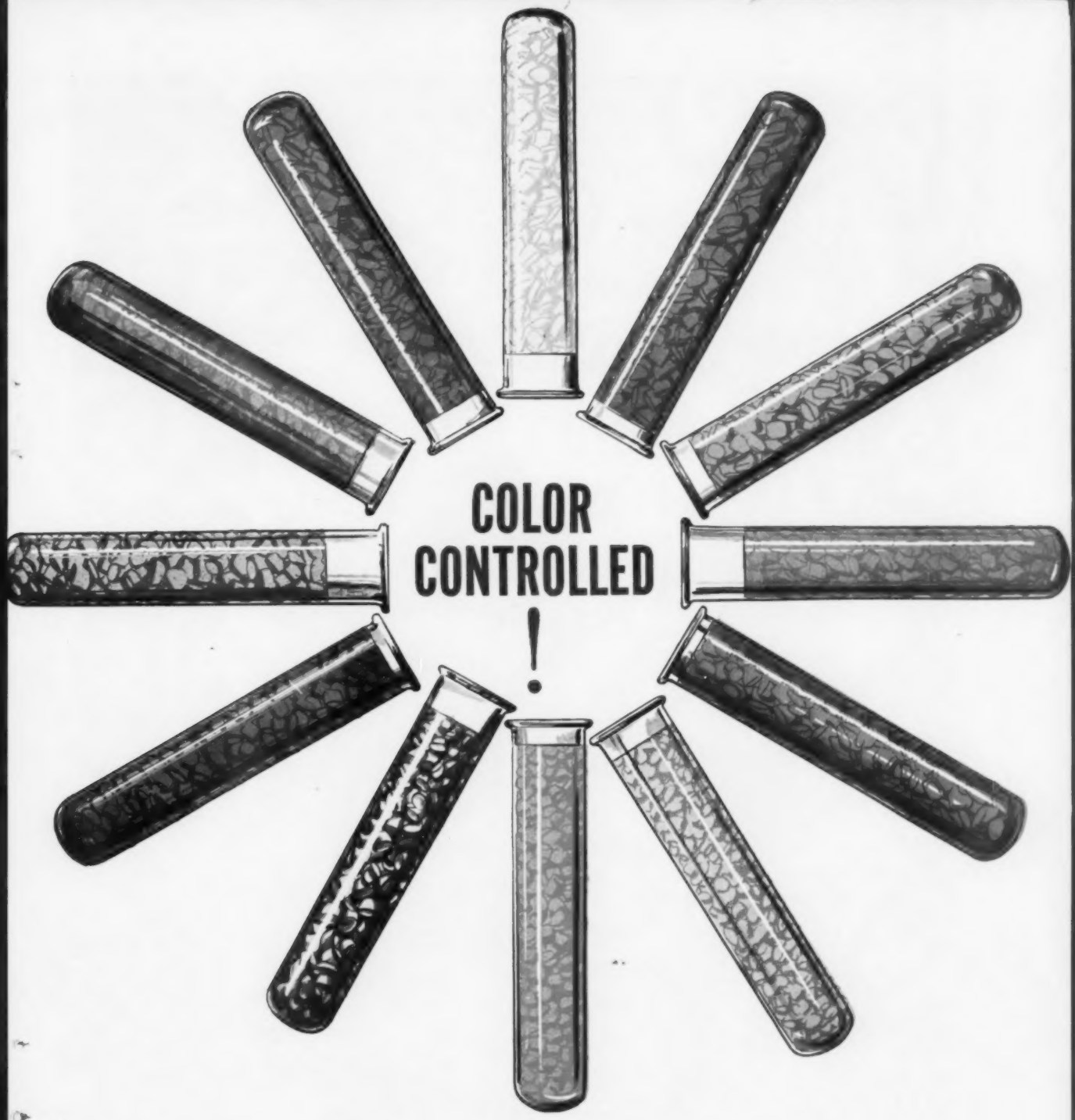


. . . AND IT CAN'T BE OUTPERFORMED

WALDRON-HARTIG

technical competence in plastics process machinery

WALDRON-HARTIG, Box 531, Westfield, N. J./a division of Midland-Ross Corporation MR



POLYPROPYLENE*, POLYETHYLENE, POLYSTYRENE, VINYL . . . carefully filled to your **exact** color and quality requirements by our laboratory experts. Cut costs . . . maintain highest quality with our uniform, dust-free pellets. Future orders guaranteed to match perfectly! Write!

*AviSun Polypropylene

A. Schulman Inc.

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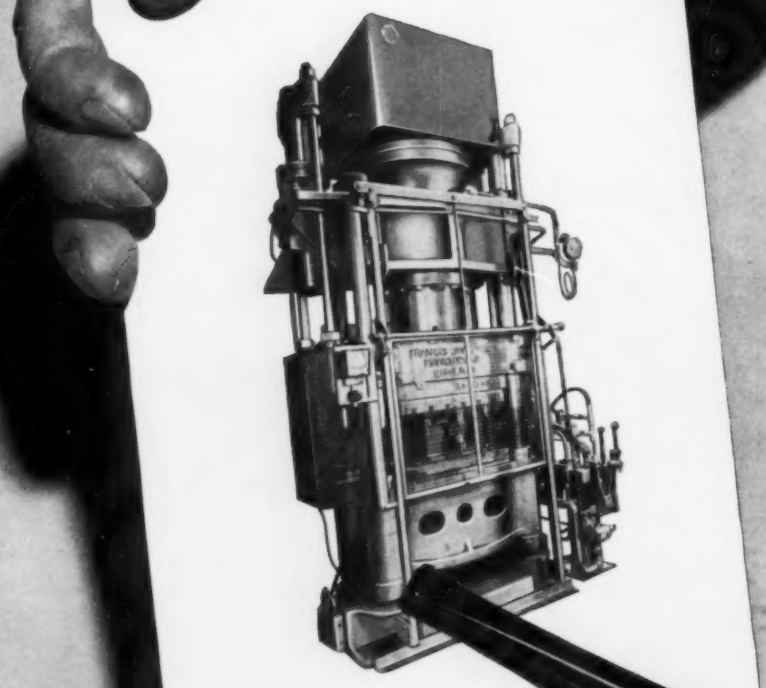
behind every

Francis Shaw machine

research·design·quality engineering

Constant research and development, close co-operation with users, advanced design, selected high quality materials... These, coupled with long experience, help to create processing machinery of unrivalled performance.



Francis Shaw hydraulic presses are tailor-made to requirements of the rubber and plastics industries. Illustrated is a 300-ton press recently installed. Shaw presses include the following design features:

* Mains or unit operation
* Steam or electrical heating
* Appropriate size for every requirement

Francis Shaw

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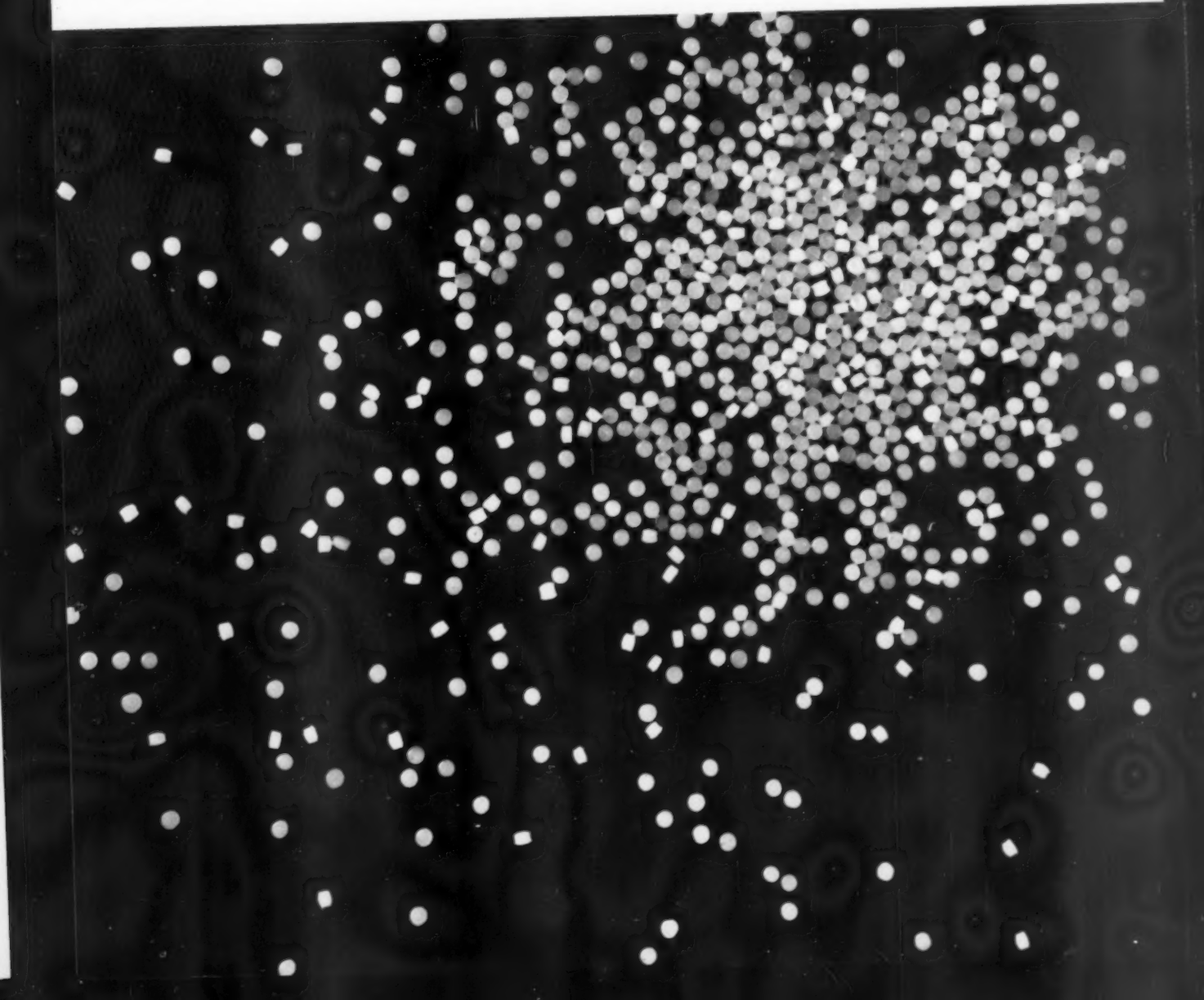
OVERSEAS AGENTS THROUGHOUT THE WORLD P4451

AMERIPOL

A NEW DURABLE HIGH DENSITY POLYETHYLENE EASILY SHAPED INTO PROFITABLE PRODUCTS



Ameripol—the only high density polyethylene

stronger, beautiful blow molded products

Refrigerator bottles . . . baseball bats . . . detergent bottles . . . flower pots . . . sprinkling cans — whatever you blow mold, you can do it easier and more economically with new Ameripol high density polyethylene from Goodrich-Gulf Chemicals. With Ameripol you get a polyethylene with superior resistance to stress cracking and thermal embrittlement. In fact, all the advantages of a high molecular weight polymer with none of the processing difficulties usually encountered. High density Ameripol handles as easily as conventional polyethylenes . . . uses standard equipment.

And that's not all. Here are other advantages you can expect from Ameripol: *Color*—in an unlimited range of shades. *Finish* that will give your products a beautiful sheen and a smooth, glass-like feel. *Machinability* — easy to cut, groove or punch.

Ameripol is opening up new horizons for plastics processors. See what this new Goodrich-Gulf product can do for you!

that combines durability with processibility

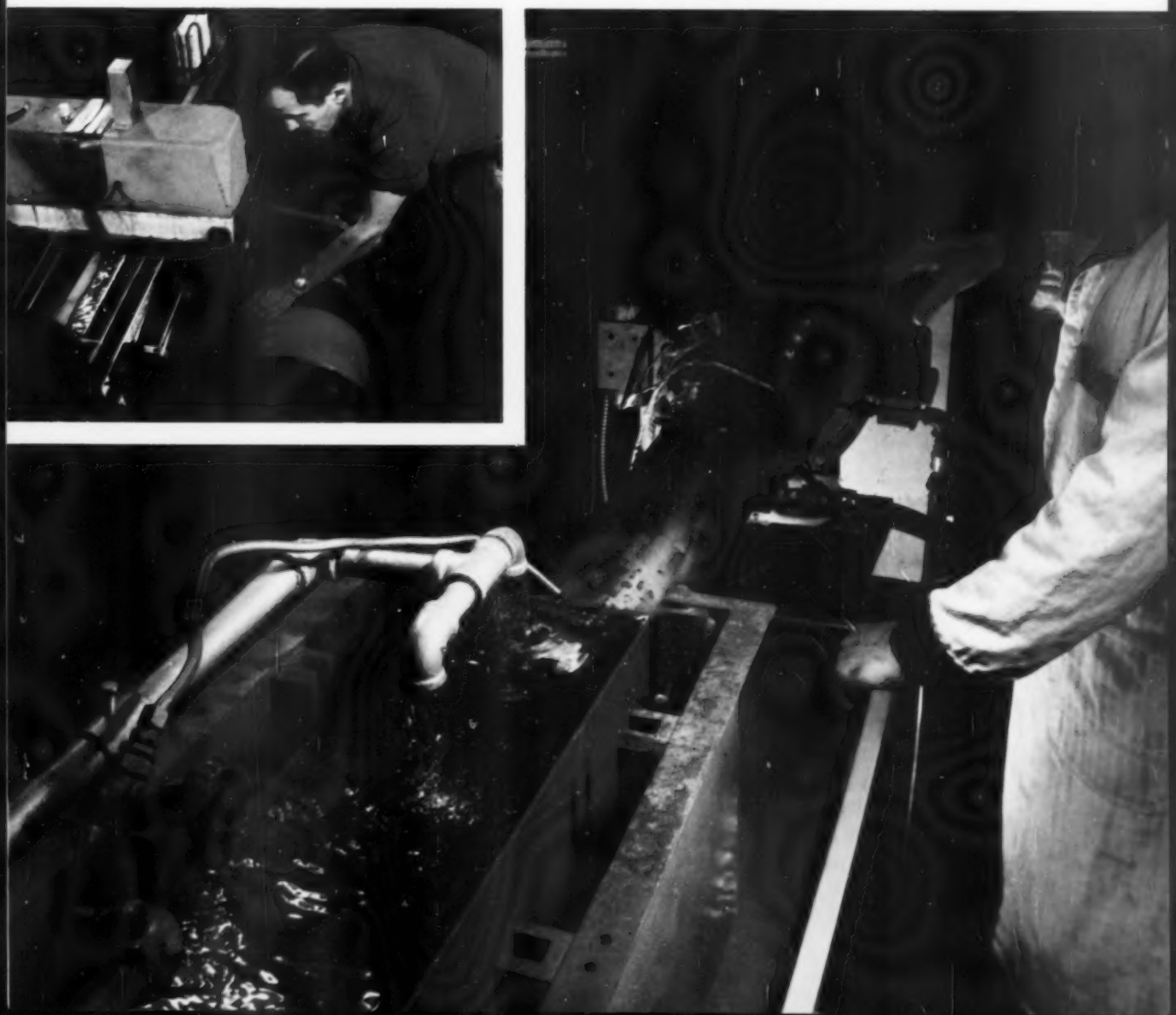
a better wire insulation, easily produced

If you're looking for a tough insulation for wire and cable, Ameripol high density polyethylene is your answer. You're assured of an insulation with excellent dielectric properties and resistance to elevated temperatures . . . a wire coating that virtually eliminates cut-through problems. All this plus easy extruding. You can use this superior material on your standard equipment and insulate wire and cable at commercial production speeds. Results: better products, better profits.

faster extrusion of smoother pipe

Goodrich-Gulf's unique high density polyethylene proves its distinct superiority as *the* material for plastic pipe. First, you'll find this high molecular weight Ameripol Polyethylene produces a *smoother* pipe, and this means faster production, bigger output.

Ameripol Polyethylene resists contamination, keeps pipe lines pollution-free. It produces pipe that resists cracking under stress, withstands impact, is easy to install. And Ameripol requires no special costly equipment or special dies. Put Ameripol Polyethylene to work for you now.



AMERIPOL POLYETHYLENE HAS SUPERIOR PROPERTIES THAT WILL PAY OFF IN YOUR PRODUCTS

	ASTM		AMERIPOL GRADE NO.		
Physical Property	**Units**	**Method**	**32**	**34**	**35**
Density	g/cc	D648-56	0.95	0.95	0.95
Molecular Weight	———		50,000	80,000	100,000
Melt Index (condition E)	g/10 min	D1238-57T	0.1-0.2	0.04-0.08	0.001
Flow Index (a) (condition F)	g/10 min	D1238-57T	24.0-28.0	8.5-9.3	4.0-5.6
Intrinsic Viscosity	———	D1601-58T	2.3-3.0	3.1-3.7	3.8-4.8
Vicat Softening Temperature	°C	D1525-58T	119	121	122
Ultimate Tensile Strength, 20 ipm	psi	D412-51T	2250	2450	2700
Tensile at Yield, 20 ipm	psi	D412-51T	3450	3450	3450
Elongation, 20 ipm	%	D412-51T	120	320	560
Impact Strength (b)					
⅛ x ½ bar	ft/lbs				
	in notch	D256-54T	19	31	36
¼ x ½ bar	"	D256-54T	8	17	24
½ x ½ bar	"	D256-54T	0.9	1.9	4.3
Stiffness in Flexure	psi	D747-50	115,000	115,000	120,000
Hardness	Shore D	D1706-59T	60	60	60
Environmental Property					
Environmental Stress Cracking (c)					
With Anti-oxidant	hrs.		65	445	>800
Without Anti-oxidant	hrs.	D1693-59T	40	230	500
Thermal Embrittlement (d)					
With Anti-oxidant	hrs.	(d)	185	>1000	>1000
Without Anti-oxidant	hrs.	(d)	70	95	700

(a) Cutoff on flow index test made at the end of 30 seconds.
(b) The impact strength test result is greatly influenced by sample size.
(c) ASTM Standard on Plastics, D1693-59T Method of Test for Environmental Stress Cracking of Type I Ethylene Plastics. This test, which has been adopted for Type I Ethylene Plastics is used herein for Type III in the absence of an official method.
(d) This test employs compression molded specimens, 5" x 0.25" x 0.05", three of which are wrapped and clamped around a ¼" mandrel. The apparatus is inserted in a nitrogen blanketed test tube which in turn is placed in an aluminum block @ 100°C. The value reported is the time until two of the three samples crack.

How to put this new polyethylene to work in your operation

It's easy. A call to Goodrich-Gulf Technical Service is all that's needed. An experienced sales engineer will come out to your plant and help you select the right grade of Ameripol for your product. You'll find that Goodrich-Gulf has the technical know-how to handle every aspect of your high density polyethylene needs – from application and production to shipping and storage. See how better products start with Ameripol high density polyethylene – Write for your Ameripol Technical Data file now!

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NEW YORK

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THE ONE TO WATCH FOR NEW DEVELOPMENTS

What's new in processing

A process of metallizing Teflon and other high temperature plastics has been announced by Joclin Mfg. Co., Orange, Conn. According to the developers, the process will deposit copper or nickel film over complex or flat surfaces. The bond between metal and substrate is claimed to be substantially stronger than that produced by current adhesive laminating techniques, but Joclin is not yet willing to release details on materials or procedure.

Testing heat treatment of conventional and linear polyethylene prior to printing or other finishing is eased by use of spray lacquers. Avondale Co., Northfield, Ill., supplies two specially formulated lacquers in aerosol cans, #5051 for linear polyethylene and #5299 for conventional. Lacquer is sprayed on the heat treated surface and allowed to dry. Scotch tape is applied over it and quickly peeled off. If the lacquer is removed by the tape, the surface has not been effectively heat treated.

Abstracts

"Practical Phenolic Molding Techniques" by E. W. Vaill, SPE Journal, May 1961, advocates automatic plunger molding, and shows how optimum preform properties, mold design, and operation can speed output and lower costs.

"Automatic Injection Molding" by John K. Neely, SPE Journal, May 1961, considers the factors in automating this process, including economics, design, raw material handling, molding, and ejection.

"Faster Welding of Thermoplastics" by G. Haim, Rubber and Plastics Age, December 1960, describes a new torch developed for speedy welding. It also covers tack welding, nozzles, and techniques for high speed welding of polyethylene, polypropylene, and rigid PVC.

"Vacuum Forming" by R. W. Harwood, Plastics, April 1961, reviews progress in materials, methods, and applications, diagrams five main techniques, and tabulates sheet forming material characteristics. Covers finishing and decorating, mold design, material cost, and applications.

"The Manufacture of Shaped Objects from PVC Foam by the Low Pressure Method" by Dipl. Ing. D. Homann, Plastics, April 1961, outlines formulations, development and perfection of the low pressure process, renewed foaming of expanded foam, and molds and heating.

"Effect of Extrusion Variables on the Fundamental Properties of Tubular Polythene Film—Part I" by P. L. Clegg and N. D. Huck, Plastics, April 1961, covers effects of extrusion variables on important optical and mechanical film properties, including nature of film surface, crystalline structure, and type of molecular orientation. Discussed and illustrated by the results obtained in experiments.

Patents

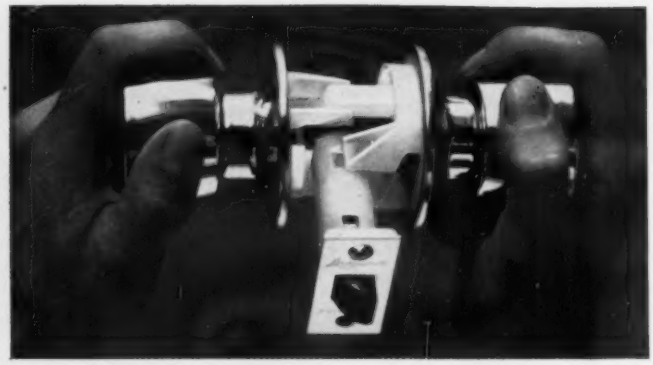
2,972,784 to Arthur S. La Pine & Co. A method of preforming a Teflon encapsulated rod magnet.

2,972,785 to Enrique G. Touceda, McLean, Va. The working surface of a die to apply pressure is formed by casting an alumina-filled polyester resin.

2,972,779 to Don Baxter, Inc. A smooth opening on polyvinyl tubing is made by grinding and dissolving the punched opening.

2,972,559 to Architectural Porcelain Constructors. A method of laminating panels to expanded polystyrene core with heat and a polystyrene-dissolving solvent.

2,971,874 to Equitable Paper Bag Co., Inc. A method of making plastic bags, each of which has a reinforcing strip enclosed in a sealed-off top compartment.



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The unique properties of Du Pont ZYTEL nylon resins are put to good use in a remarkable range of products. Four examples, out of hundreds: In power drills, ZYTEL replaces metals for housings, providing insulation, impact resistance, light weight, comfortable handling. In locksets, interior parts of ZYTEL need no lubrication, last longer, operate more smoothly and quietly. In tape dispensers, molded gears and shafts of low-friction ZYTEL replace more expensive machined steel parts. These intricate parts are easily molded, eliminate the need for bearings. In vacuum cleaners, turbine fans molded of ZYTEL offer high strength in thin sections, resist metallic impact. In all applications, ZYTEL offers production economies as well as improved design.

What can ZYTEL do for *your* product?

For information on the wide variety of ZYTEL nylon resins, each tailored to meet specific design needs, write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. PT-6, Room 2507Z, Nemours Bldg., Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.

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LOCKSET for Lockwood Hardware Manufacturing Company, Fitchburg, Mass. and POWER DRILL with insulating housing of ZYTEL for Millers Falls Company, Greenfield, Massachusetts, by Nylon Products Corp., affiliated with F. J. Kirk Molding Co., Clinton, Mass. • VACUUM CLEANER with turbine fan wheel of ZYTEL molded by Chicago Molded Products Corporation, for Sunbeam Corporation, both of Chicago. • TAPE DISPENSER with gears and shafts of ZYTEL molded by Northwest Plastics, Inc., St. Paul, Minn., for Specialty Manufacturing Co. and Minnesota Mining and Manufacturing Co., both of St. Paul, Minn.

Hot sun causes some vinyls to give off volatiles that "fog" windows. Bar-O-Sil stabilizer inhibits this condition.

Tests show Bar-O-Sil* stabilizer inhibits troublesome "fogging" of car windows due to vinyls

Bar-O-Sil supplementary stabilizer also checks spewing, crocking, plating and blocking in processing of vinyl film, sheeting and extrusions.

Car manufacturers noted that heat causes some vinyl upholsteries to give off volatiles that "fog" windows. Tests show that Bar-O-Sil, complex barium silicate supplementary stabilizer, inhibits this condition in vinyls. In addition to alleviating this problem, Bar-O-Sil promotes the following desired characteristics in vinyl film, sheeting and extrusions.

Promotes colorant performance and "dry hand" qualities

Bar-O-Sil has a high adsorptive capacity that provides improved control of migration of color and plastic ingredients to the surface. Bar-O-Sil also has low reactivity with sensitive colorants. These important properties contribute to more effective control of bleeding, spewing and crocking during processing – promote desired color and "dry hand" qualities in vinyl film, sheeting and extrusions.

Speeds production runs by reducing plate-out

In all stabilizing systems containing barium, cadmium or zinc compounds, Bar-O-Sil reduces plate-out on rollers during calendering. In this way, Bar-O-Sil saves time by permitting quick color changeovers, and speeds production runs.

Other helpful benefits

Bar-O-Sil's high adsorptive capacity controls blocking of vinyls in storage and in use. The presence of Bar-O-Sil is important, especially when post-laminating or post-embossing operations are to be conducted as a separate step, some time after the initial processing stage.

Send coupon for more information

For detailed information covering the many useful properties imparted to vinyls by Bar-O-Sil supplementary stabilizer, fill out the coupon below.

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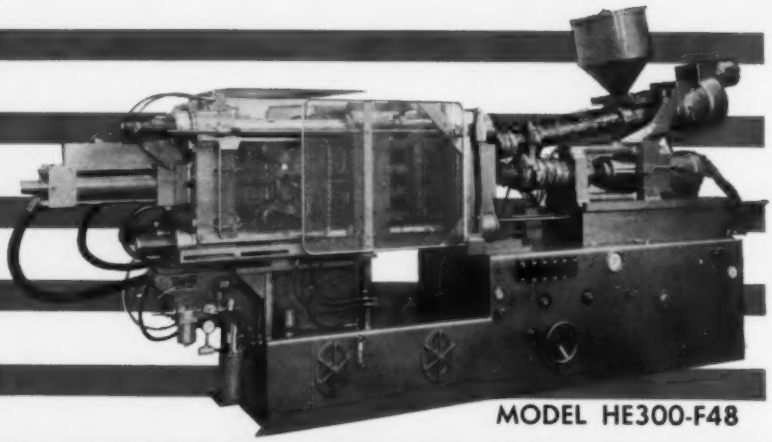
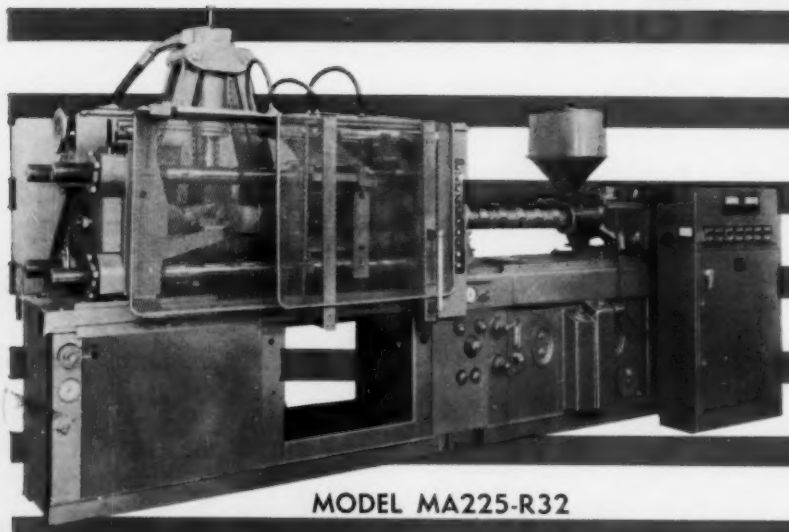


MODEL HE300-F48



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CHEMICAL RESISTANCE TESTS SCREEN PLASTICS FOR PRODUCT DESIGN APPLICATIONS

In selecting plastics for design use where the product will be subjected to a chemical environment, chemical tests are essential for primary screening purposes. The chemical resistance of a plastic is a physio-chemical effect, and is dependent upon chemical concentration, temperature and time.

Obviously, the most accurate test results are obtained where a prototype part is subjected to conditions which parallel the proposed conditions of actual use. Where this is impractical, however, it is generally possible to predict whether the plastic will stand up in use, using ASTM D543-56T test method.

During this environmental test, in which the plastic is immersed in a test reagent for a period of seven days, the test part may be affected in a number of ways. It may change in size or shape, in color or weight. It may craze, crack, or lose gloss; and strength and stiffness may be reduced. However, the primary measure of chemical sensitivity is the rate of weight increase of the sample. Test effects, combined with visual observation, yield considerable information on probable in-use performance of the plastic.

The data presented in the table below were obtained using the ASTM D543-56T test method, except that the recommended immersion period was extended from 7 days to 4 weeks. The test temperature was 75°F., representing ambient conditions.

Data in the table were developed using pure reagents. Where plastics will be exposed to proprietary compounds, usually formulated over a wide range of chemical compositions, results may vary. In such cases, it is recommended that tests be carried out using the specific compound in question, to determine chemical resistance of the plastic. Chemical resistance tests should be made in the absence of vibration and stress. Even in cases where more severe applications are to be expected, these data are useful in determining whether actual service tests or trial installations should be made.

Environmental test data developed by Dow Plastics Technical Service Engineers are available to designers and plastics engineers in all fields of plastics application. For detailed information on these studies, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1733DT6.

GENERAL CHEMICAL RESISTANCE CHARACTERISTICS OF SOME DOW PLASTICS

Test Temperature—75° F. Test Period—FOUR WEEKS

CHEMICAL CLASS	DOW PLASTICS MOLDING MATERIALS						
	Ethocel®	Polyethylene	Saran	Styron®		Tyril®	Zerlon®
	—	Types I, II & III	—	General Purpose Grades	Impact Grades	—	—
Acids, Inorganic							
weak	E	E	E	E	G	E	E
strong	P	E	E	E	G	G	NR
strong oxidizing	P	G	G	F	F	NR	NR
Acids, Organic							
weak	E	E	E	E	E	E	G
strong	F	E	E	F	G	NR	NR
Alcohols	NR	E	E	E	G	F	NR
Aldehydes	NR	E	G	NR	NR	NR	NR
Amines							
aliphatic	E	E	G	E	E	E	E
aromatic	E	E	P	NR	NR	NR	NR
Bases	G	E	G	E	E	E	E
Beverages	G	E	E	E	E	E	E
Condiments	G	E	E	G	G	E	G
Esters	NR	G	E	NR	NR	NR	NR
Foodstuffs	E	E	E	E	E	E	E
Glycols							
polyglycols	G	E	E	E	E	E	E
polyglycol ethers	NR	E	G	NR	NR	NR	NR
Hydrocarbons							
aliphatic	NR	NR	G	NR	NR	E	F
aromatic	P	NR	F	NR	NR	NR	NR
chlorinated	NR	NR	G	NR	NR	NR	NR
Insecticides	NR	G	F	NR	NR	NR	NR
Ketones	NR	G	F	NR	NR	NR	NR
Oils							
essential oils	NR	F	E	NR	NR	NR	NR
vegetable oils	E	E	E	G	G	E	G
Pharmaceuticals	G	E	E	E	E	E	E
Salts	G	E	E	E	E	E	E

E—Excellent, unaffected.
G—Good, slight discoloration. Expected life of the plastic, months to years.
F—Fair, moderate discoloration or dimensional change. Expected life, weeks to months.
P—Poor, considerable change. Expected life, days.
NR—Not recommended. Severe attack.

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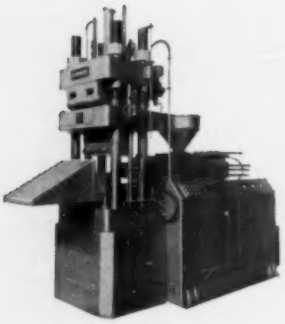
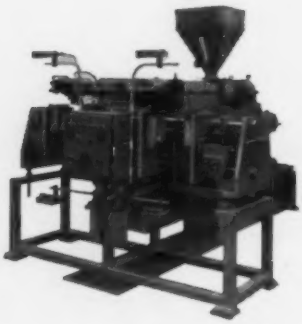


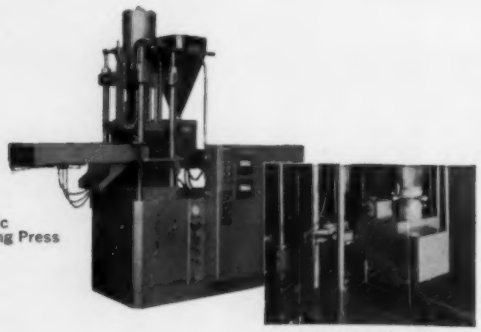
New Model 706 Automatic Injection Molding Press with screw plasticator

The new Model 706 Press with Stokes-designed screw plasticator brings unsurpassed product uniformity to truly automatic injection molding. This new molding press offers all the proven advantages of Stokes truly automatic operation with the added feature of controlled, uniform plasticating. Only Stokes offers proven nozzle shut-off and pressure pre-pack with screw plastication . . . providing faster production of strain-free parts. The new press automatically plasticates, molds, de-gates, ejects, and sorts. Even the sprues and runners are channelled into separate bins.

Two new Dual-Manifold Blow Molding Machines with accumulators provide faster cycles. Backed by more than 25 years of plastic processing experience, these new Stokes blow molders give high-speed production, coupled with the operating flexibility of dual-manifold design. Rugged construction ensures extra operating stability. Integrated design of blow molders, extruders, and accumulators simplifies set-up . . . gives maximum operating efficiency.



Model 855-2 Blow Molder with extruder



Model 741 Automatic Compression Molding Press

Integral preheater

Automatic Compression Molding Press with Integral Preheater cuts curing time by 15% to 25%. The exclusive, patented preheater combines agitation and preheating in one operation. This combination produces superior parts and eliminates mold breathing since gases are dispelled prior to molding. Results: reduced cycle time and higher quality molded products.

Take advantage of these and all the other advances built into Stokes presses. Get complete technical data by contacting your nearest Stokes representative. He'll be glad to discuss your particular requirements and to make available to you the facilities of Stokes Laboratory and Advisory Services.

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Using D-M-E Standard Mold Bases and component parts, you can develop greater production flexibility . . . your way to greater production savings!

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Whether for injection or compression molding, D-M-E Standard Mold Bases enable you to work with one single reliable source. This one-call, immediate delivery service can help you to cut production costs . . . and increase profits!

MOLD DESIGNER: D-M-E standard components are fully interchangeable: Replacements can be made without special fitting or reworking. D-M-E enables you to work with greater freedom by providing a selection of over 7,000 catalogued mold base combinations. And D-M-E Master Layouts enable designers to devote more time to cavity layout.

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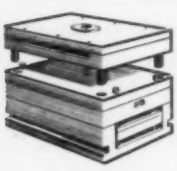

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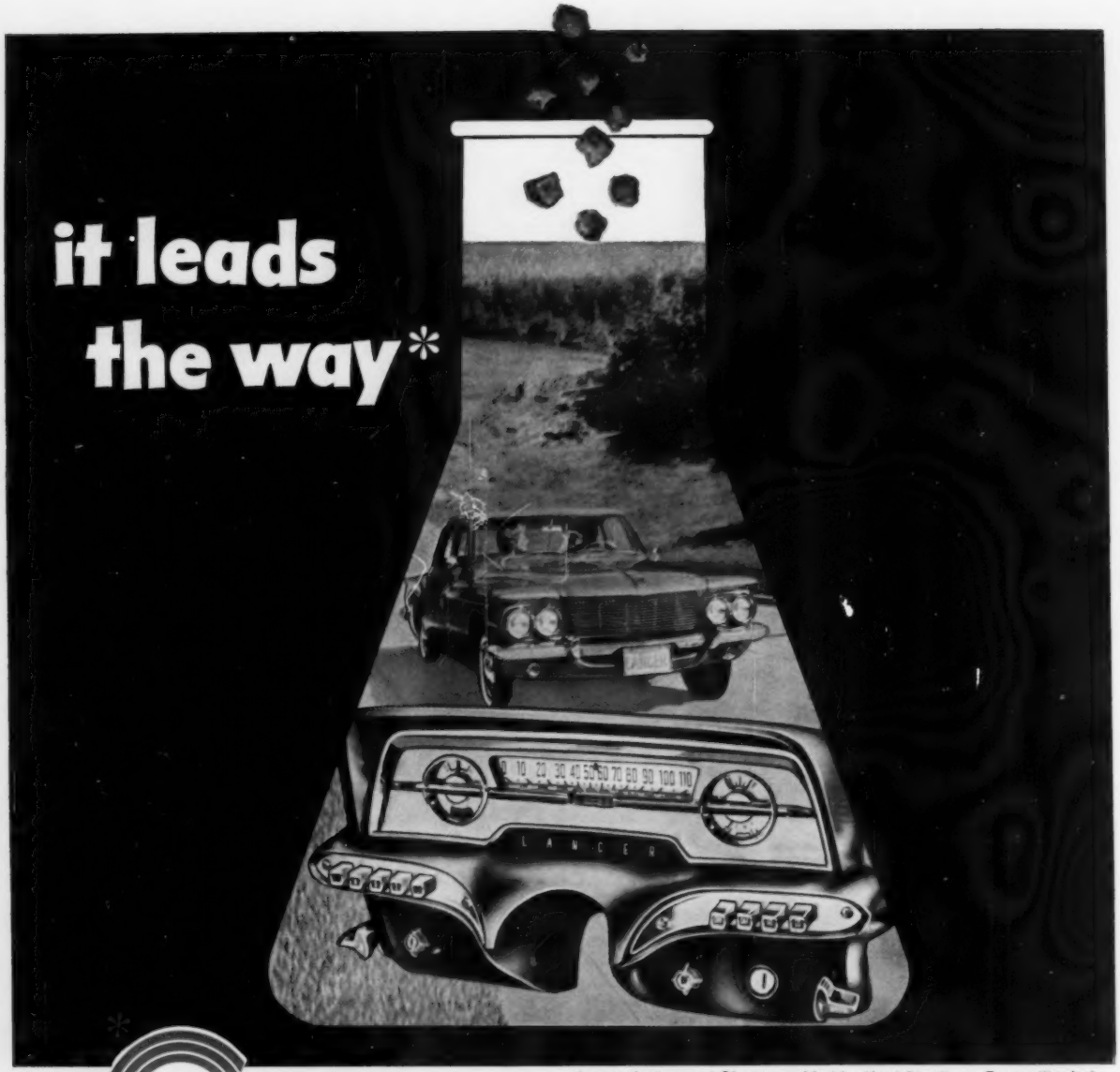

Lancer Instrument Cluster molded by Kent Plastics — Evansville, Ind.

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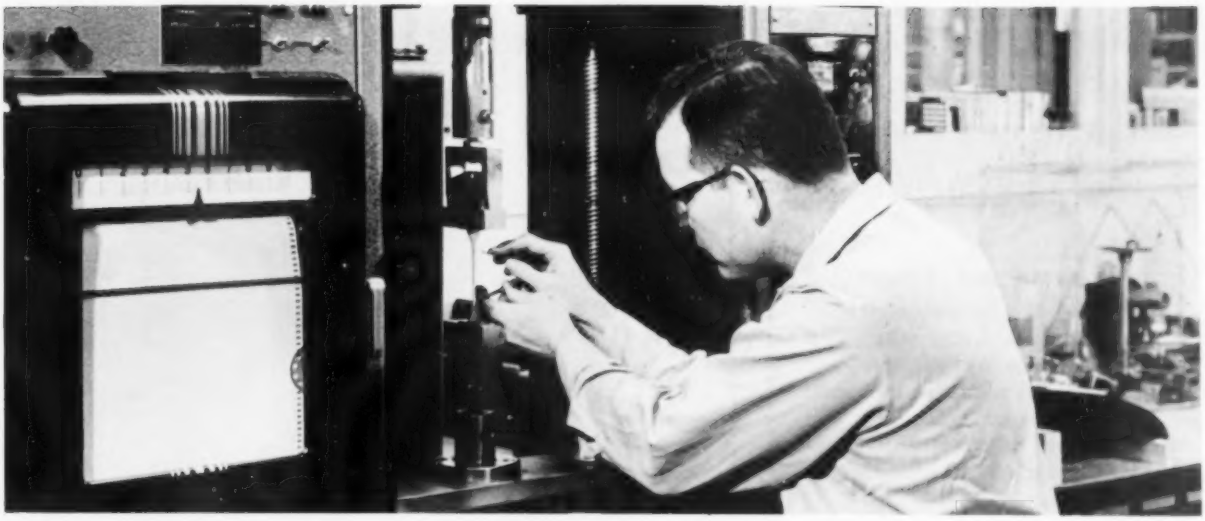

Monsanto PLASTICIZER COUNCIL

A staff of technical consultants, with full laboratory facilities

. . . to guide you in selecting or developing the best plasticizing system for your product, your process, or your plant.

Monsanto's Plasticizer Council staff aggregates more than 250 years of experience in the technology of plasticizing. They bring to bear a fully equipped special laboratory for complete, competent guidance for our customers.

When the key to solving your resin formulation, processing, or performance problem appears to be an improved plasticizer system, *your* know-how in plastics and *ours* in plasticizers can be teamed together for mutual advantages.

The user's best interest is always the objective of Monsanto's Plasticizer Council. This team of busy specialists selects plasticizers from the widest variety available anywhere, exercising great care to approximate customers' actual processing conditions. The Plasticizer Council can guide you to efficient one-, two-, or three-component plasticizer systems; can recommend a variety of extenders or secondary plasticizers to help minimize cost—*without restricting plasticizer selection to any one type or narrow group in which there is a vested interest.*

It pays to consult the Plasticizer Council. You can quickly obtain these valuable services—along with the industry's most diversified line of quality plasticizers (*more than 80!*)—by contacting one of the following offices of Monsanto Chemical Company: ATLANTA 9 (*TRinity 6-0777*) • BOSTON 49 (*DUnkirk 7-5010*) • CHICAGO 11 (*WHitehall 4-6750*) • CINCINNATI 6 (*WOodburn 1-3677*) • CLEVELAND 15 (*SUperior 1-3830*) • DETROIT 23 (*BRoadway 3-7090*) • HOUSTON 5 (*JAckson 6-2551*) • LOS ANGELES 22 (*RAymond 3-2493*) • MINNEAPOLIS 2 (*FEderal 9-4651*) • NEW YORK 22 (*PLaza 9-8200*) • PITTSBURGH 28 (*LOcust 3-4010*) • ST. LOUIS 66 (*WYdown 3-1000*) • SAN FRANCISCO 4 (*YUkon 6-6232*) • SEATTLE 4 (*MAin 2-4203*) • SYRACUSE 3 (*GRanite 4-6001*) • WILMINGTON 3 (*OLympia 8-6423*)

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SAVE ON MATERIALS HANDLING

Bulk-storage tanks installed at your plant can greatly reduce your materials-handling expenses: *lower labor costs and virtually no material spillage.* Monsanto can help you design your bulk-storage facilities and offer suggestions on their successful operation.

SAVE BY MIXED SHIPMENTS

Bulk or mixed-carload shipment prices average 10% below LTL or LCL costs. Two or three plasticizers, shipped in compartmented tank trucks or tank cars, are each billed at the tank truck or tank car rate. Any combination of drummed plasticizers may be shipped at the full truck or carload rate.

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Your orders receive our prompt attention, *and we always strive to meet your delivery requirements.*

SUPPLIES ARE NEAR

Monsanto can ship tank trucks, tank cars, or carloads of most plasticizers from shipping points strategically located near every major plastics-manufacturing point. Producing plants at East St. Louis, Ill.; St. Louis, Mo.; Everett, Mass.; Long Beach, Calif.; and Anniston, Ala. Additional bulk storage at Akron, Ohio; Greensboro, N. C.; Houston, Texas; Miami, Florida; and Perth Amboy, N. J. Also 14 more warehouses blanket the nation for fast-delivery shipments.

CHEMICAL MATERIALS CATALOG, *page 432, gives technical and shipping information on forty Monsanto Plasticizers.*

How SANTICIZER® 409 gives vinyl products high-priced properties at the lowest cost of any premium polymeric plasticizer

PERFORMANCE: SANTICIZER 409 *stays put.* Its compatibility-stability is superior, under highly humid conditions, particularly when formulated with heat-stabilizing epoxy plasticizers. SANTICIZER 409 stubbornly resists migration to polystyrene—and to both natural and synthetic rubbers—as well as extraction by solvents. Stability to light and heat is exceptional. There's hardly a trace of odor or color.

PROCESSING: The good solvating action of SANTICIZER 409 can boost your output, too. Promotes fast fusion and extrusion. Helps prevent "fisheyes," roughness, and pinholes.

PRICE: SANTICIZER 409—*at 4¢ to 6¢ per lb. LESS than other premium-quality polymerics*—imparts top-quality performance to many kinds of vinyl products.

PROOF: Try it . . . "on paper," in the laboratory, in the plant. Compare SANTICIZER 409 with *any* other polymeric plasticizer (price, properties, stability, ease of processing). You will see that SANTICIZER 409 gives *more profit per unit volume of vinyl compound.*

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- **105° wire compound with exceptional electrical properties and retention of elongation.**
- **permanent, adhesive-backed film.**
- **migration-resistant, low-odor refrigerator gasketing.**

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How MOD-EPOX® liquefies viscous epoxy resins and "liquidates" some of the cost

PERFORMANCE: Reactive MOD-EPOX reduces epoxy resin viscosity as much as 75%, combines *chemically* in the curing to become part of the resin. This means you can use more filler, yet have faster flow, less entrapped air, fewer rejected finished parts. And final properties are actually *improved:*

FLEXURAL STRENGTH OF 4-PLY GLASS FIBER-EPOXY LAMINATES (ASTM D638)

FORMULATION:	Control	with MOD-EPOX
MOD-EPOX	—	25
liquid epoxy resin	100	100
diethylenetriamine	12	8
magnesium oxide (fluffy)	—	0.25
FLEXURAL STRENGTH:	**psi**	**psi**
original	42,400	48,400
ketone—40 hrs. @ room temp.	42,400	47,700
water—40 hrs. @ 100°C.	29,400	37,600
10% caustic—27 hrs. @ 100°C.	8,500	9,200

Epoxy resins modified with MOD-EPOX for better flow and lower cost show better dimensional stability—lower power factor—equivalent hardness—and higher adhesive strength (*shear bond strength of a standard epoxy adhesive increases more than 50%, steel-to-steel*).

ECONOMY: NOW . . . MOD-EPOX at 36¢/lb.* costs less than any grade or brand of epoxy resin, 50-75% less than most other modifiers . . . AND reduces the curing-agent requirements to about ⅔ of usual amounts.

FACTS: Technical Bulletin PL-313 gives complete performance data—including specific details on how MOD-EPOX can help you make:

- **easy-handling electronic potting compounds.**
- **low-cost auto-body-solder formulations.**
- **high-strength casting and encapsulating compounds.**
- **tenacious adhesives for metals and glass.**

*T/L and C/L, F. O. B. Monsanto, Illinois

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I'd like more facts. Please send me the literature checked below:

☐ **Technical Bulletin PL-409** on SANTICIZER® 409 . . . more-for-the-money polymeric plasticizer

☐ **Technical Bulletin PL-313** on Monsanto MOD-EPOX® . . . key to better, lower-cost epoxy resins

☐ **Technical Bulletin PL-160** on SANTICIZER® 160 . . . quick-fusing, stain-resisting phthalate ester

☐ **Technical Bulletin PL-306** . . . tells how Monsanto AROCLOR® Plasticizers impart high resistance to flame and chemicals at low, low cost

☐ **Technical Bulletin PL-327** . . . tells how to formulate better protective coatings with Monsanto plasticizers

☐ **Technical Bulletin PL-314** . . . tells how to save time, labor, and material expense in the bulk handling and storage of Monsanto plasticizers

How SANTICIZER® 160 speeds processing and cuts costs of nonstaining PVC film and sheeting

PERFORMANCE: No other plasticizer can make film, sheeting, and floor covering so *STAIN-SAFE*—virtually impervious to asphalt, tar, grease, mustard, catsup, coffee, and other stainmakers. SANTICIZER 160 (butyl benzyl phthalate) also imparts toughness, high gloss, *and outstanding tear strength and dimensional stability.*

PROCESSING: Quick-fusing SANTICIZER 160 speeds Banbury mixing, milling, and calendering—*at lower processing temperatures.*

ECONOMY: SANTICIZER 160 is one of the lowest-priced primary plasticizers for vinyls. With its high tolerance for fillers and its high compatibility—*150 PHR for poly(vinyl chloride), 75 PHR for poly(vinyl acetate)*—it offers compounders savings on material, savings on formulation.

"TAILORED" BLENDS: In large-volume applications, when several plasticizers are used together in a fixed ratio for optimum performance, Monsanto can usually *custom blend* them to your specifications . . . to reduce your storage-facility requirements; eliminate mixing error or variation; and reduce inventory requirements, ordering costs, and production expense.

FACTS: Technical Bulletin PL-160 gives complete performance data—including specific details on how SANTICIZER 160 *also* can help you make:

- **lower-cure-temperature plastisols and organosols.**
- **high-gloss, water-resistant lacquers.**
- **economical vinyl chloride-vinyl acetate emulsions.**

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Industrial Chemical Development Dept.

At Eastman you can find plastics to shape a new world of products

Ideally suited to modern high-speed vacuum-forming techniques, Tenite plastics are cutting costs sharply for many manufacturers

Vacuum forming—one of the oldest techniques of fabricating plastics, but only in recent years adapted to speedy modern methods—is now in the foreground of interest as an important method of shaping plastics products for today's market.

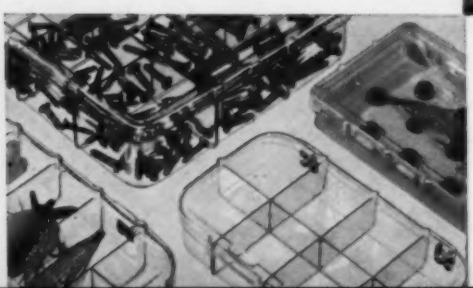
Starting material for a vacuum-forming operation is an extruded thermoplastic sheet. In simplest terms, vacuum forming involves only two steps, both performed on the same machine. The first step consists of clamping the flat sheet of plastic in a frame above the waiting mold and heating it (with built-in heaters) to the required forming temperature. In the second step, the heated sheet is brought down into close contact with the mold, suction is applied, and atmospheric pressure then forces the heat-softened sheet over and into the contours of the mold.

Sheet extruded from any of the Tenite plastics is well-suited to vacuum forming. Typical commercial products made of these plastics are shown on these pages. They illustrate the diverse shapes and uses to which vacuum forming can be adapted. An outstanding advantage of the Tenite cellulosics—Tenite Butyrate, Tenite Propionate and Tenite Acetate—is their low specific heat which speeds both heating and cooling. Sheet of these plastics can be formed quickly and economically into tough, lightweight, highly impact-resistant products of enduring luster.

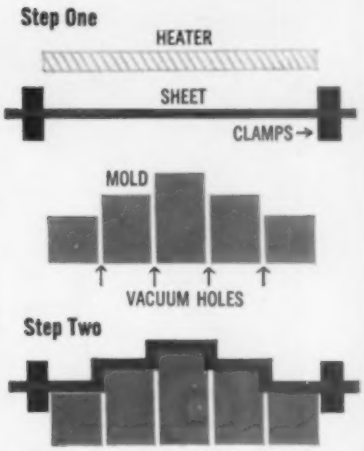
For products that are to be used outdoors, special formulations of Tenite Butyrate are available which provide excellent weather resistance and dimensional stability.

Tenite Polyethylene and Tenite Polypropylene are other Eastman plastics useful in vacuum forming. While slower to heat and cool than sheet of the cellulosics, these can be more satisfactorily formed in molds with sharp angles and offer many physical and chemical properties useful in housewares, industrial products, toys and packaging.

All Tenite plastics are available in a virtually unlimited range of colors. Over the years, the Tenite Color Laboratory has developed formulations in almost 43,000 different colors and color effects. For many applications, colored sheet can be used to yield an integrally colored product, eliminating the need for a separate decorating or painting operation. In other applica-



HOW VACUUM FORMING WORKS



NOTE: The above diagrams depict a simple vacuum-forming operation. There are many variations of this method, including some in which air pressure or mechanical pressure replaces the use of a vacuum.

tions, such as signs, clear-transparent sheet may be used, with the decoration being applied either before forming (by use of distortion printing) or after forming. It should be noted that even shapes which at first appear impossible to vacuum form can be produced by this method. For example, by using a "plug-assist" (to permit a deep draw), wastebaskets 8½" in diameter and 11½" deep have been vacuum formed from sheet of Tenite Butyrate. Similarly, spherical globes for toys and outdoor lanterns have been produced at low cost by vacuum forming two hemispheres and then solvent-cementing them together.

An important advantage of vacuum forming is the low cost of the necessary molds... often only 1/20th to 1/10th as much as those for injection molding. As a matter of fact, very inexpensive molds can be cast from plaster or tooled from hardwood or pressed wood to use on test runs, developmental designs, or single or short-run production.

The obvious economies inherent in vacuum forming have helped the technique win quick favor in many fields. In the manufacture of outdoor signs, displays, toys, housewares, decorative and lighting panels, vacuum forming is now a leading production method.

Vacuum forming also makes possible the rapid packaging of merchandise in bubble, blister or skin packs. Here, short heating and cooling cycles are particularly important because of the high speeds at which the packaging machines operate.

Perhaps vacuum forming with Tenite plastics could help you cut costs or speed production of some item you are now making or planning to make in the future. We'll be glad to help you explore its advantages and evaluate its merit.

The comprehensive story of how Tenite plastics are being used in this new manufacturing process is told in a 20-page booklet, "VACUUM FORMING." For your free copy, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENN.

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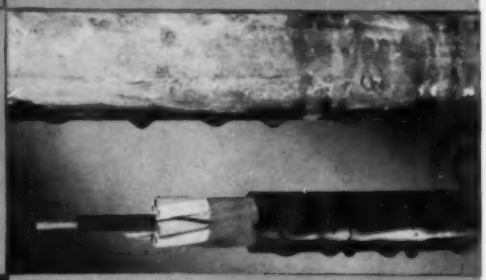
Harflex 330 features good electric properties, including high dielectric strength both dry and after immersion in water, plus rugged resistance to copper corrosion



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Editorial: More on controls and standards

This month's column "Exploring Fabrication Techniques" is concerned with methods for holding tighter tolerances on plastic film used in the packaging industry. It describes equipment available for this purpose; some of which runs very expensive, other which is quite reasonable. One thing is certain—some type of control equipment is necessary if the extruder and his customer, the converter, is to stay in business!

Just why is this control so necessary? The answer is, as usual, competition. And it's a type of competition which can't be met merely by lowering the price, and thus the profit margin. The profit margin is already cut to the bone. It's a competition involving technology.

The industry standards quoted in the "Exploring Fabrication Techniques" column were established voluntarily by extruders, and were considered sufficiently tight at the time. Now, however, improved production techniques plus vertical and other types of integration within the plastics industry have made resin available to many at a preferred rate. These extruders can guarantee exact footage delivery to their customers even if their film gage runs over that stipulated.

And this is not all they have done! They have invested in gage equipment which assures the meeting of tolerances and prevents material waste. This sounds like more cases of big companies devouring the small. But it doesn't have to happen. True, it does require some initial investment and a good deal of initiative and planning, but must everything be handed us on a silver—excuse me—plastic platter?

One thing gage controls give you immediately—up to 10% added material already processed and ready to sell. This is in addition to the boost they give your reputation as a reliable processor. The day of the sloppy molder and the quick buck is over. Consumers are demanding better engineered, more dependable products. The plastics industry, too, demands them. Quality control and standardization have become musts. Why buck the tide?

In July, PLASTICS TECHNOLOGY carries its fourth annual listing of competitive data on domestically produced and domestically available injection molding machines. This was our first major effort to aid the cause of standardization within the plastics industry. We have since carried data on extrusion machines, compression and transfer presses, blow molding machines, and thermoforming units.

Many have told us they considered these lists a real contribution towards performing a badly-needed task. Watch for the July list, and send us your comments. We are at your service.

Jim Dugan

Editor

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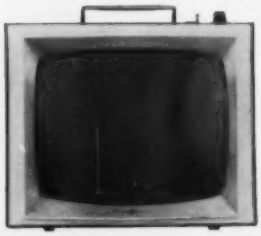
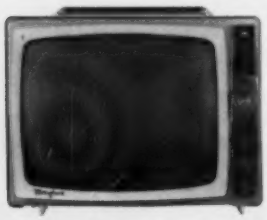
ADMIRAL parts molded of TMD 5161 by Superior Plastics, Inc.; J. P. Gits Molding Corp.



GENERAL ELECTRIC parts molded of TMD 5161 by Buffalo Molded Products; Plastic Inlays, Inc.; Presque Isle Plastics, Inc.

PHILCO parts molded of TMD 5161 by Champion Molded Plastics, Inc.; Buffalo Molded Products; St. Regis Paper Co.

SYLVANIA parts molded of TMD 5161 by Buffalo Molded Products; Presque Isle Plastics Inc.; Plastic Inlays, Inc.; St. Regis Paper Co.



WESTINGHOUSE parts molded of TMD 5161 by Plastic-Ware, Inc.; St. Regis Paper Co.

WARWICK (Sears-Roebuck) parts molded of TMD 5161 by Sinko Mfg. Co.; General American Transportation Corp.; Amos Molded Plastics; Plastic-Ware, Inc.

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It could be the answer to your parts problems!

If you require heat resistance in a high-impact styrene . . . good retention of impact strength . . . high gloss . . . useable toughness at low temperatures, BAKELITE TMD 5161 has them all! It possesses the good molding latitude and flow properties of lower impact styrene grades.

General acceptance by leading TV manufacturers for assembly-line production of large intricate parts is proof of its outstanding performance characteristics.

Versatile BAKELITE TMD 5161 is also used for housewares, battery cases, and industrial applications where a combination of heat resistance and high-impact strength is desired.

Want more information? Write Dept. IS-105F, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Ave., New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

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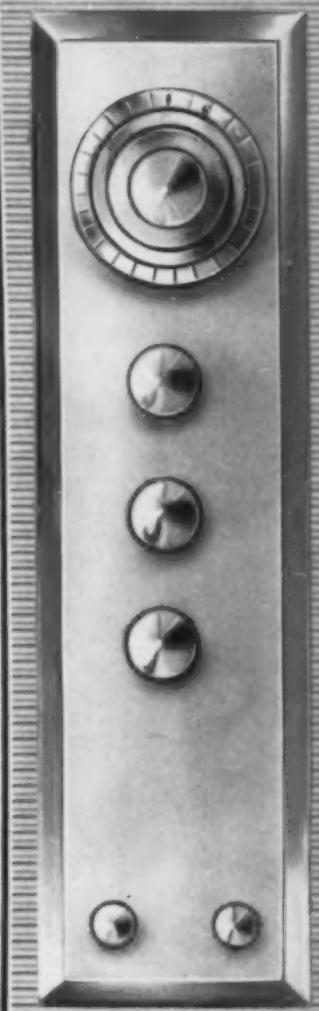

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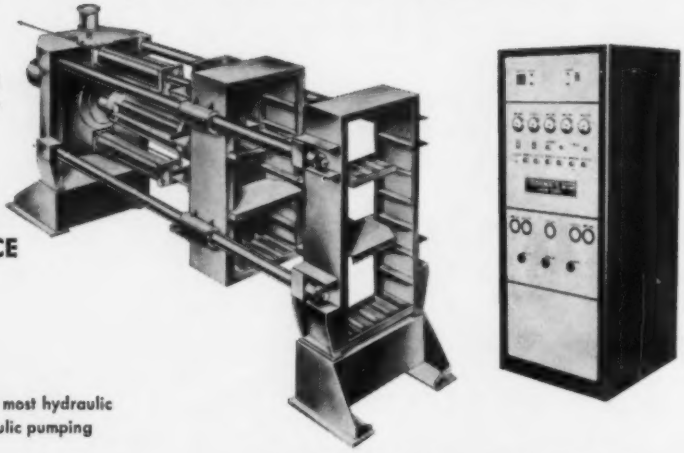

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734 — Soft seam, foam to foam
879 — Non-flammable solvent — 734

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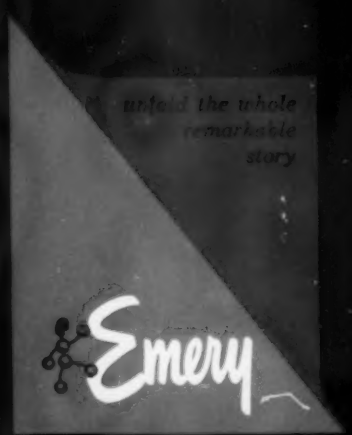

NEW PLASTOLEIN PLASTICIZERS

Check Plastolein Polymeric performance on eight important properties against two leading competitors →

4 NEW POLYMERICS join famous Plastolein® 9720

now the most complete line of low cost polymeric plasticizers in the industry

Emery research has achieved a significant breakthrough in the field of polymeric plasticizers. Four new polymerics have been introduced to complement Plastolein 9720, the industry's largest selling polymeric. Together, they now give you a single source for a wide range of your plasticizer needs. Although Plastolein 9720 will continue to be the choice in uses demanding its ease of processing and low viscosity, the four new plasticizers meet other needs:

Plastolein 9722: An improved version of Plastolein 9720 in humidity and outdoor aging, compatability, extraction and migration—at the same low cost. (Formerly Emery 3282-D)

Plastolein 9730: Now, the lowest cost polymeric plasticizer featuring low migration properties, excellent outdoor stability, and good soapy water resistance. (Formerly Emery 3311-D)

Plastolein 9750: A good, general-purpose, medium molecular weight polymeric at low cost, with excellent soapy water extraction and outdoor stability. (Formerly Emery 3313-D)

Plastolein 9765: The medium molecular weight polymeric plasticizer offering the best all-around permanence. Its cost is low, humidity aging outstanding, and extraction resistance tops. Special deodorized grade available. (Formerly Emery 3314-D)

POLYMERIC PLASTICIZERS FOR MANY USES

	Plastolein 9720	Plastolein 9722	Plastolein 9730	Plastolein 9750	Plastolein 9765
Coated upholstery fabrics	■	■	■	■	■
Unsupported films	■	■	■	■	■
Baby wear	■	■	■	■	■
Wall coverings	■	■	■	■	■
Vinyl-metal laminates	■	■	■	■	■
Shoe constructions	■	■	■	■	■
Surgical tapes				■	■
Industrial tapes		■	■	■	■
Plastisols, organosols	■	■	■	■	■
Coated paper	■	■	■	■	■
Pigment grinding	■	■		■	■
Refrigerator gaskets					■
Flooring	■	■	■	■	■
Hospital sheeting					■
Crash pads				■	■
Vinyl foam	■	■	■		

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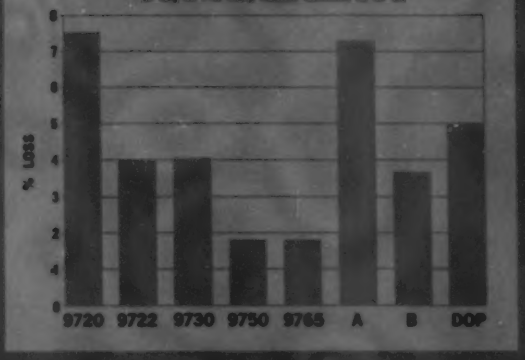
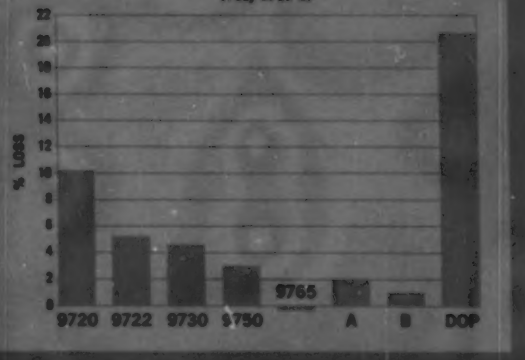
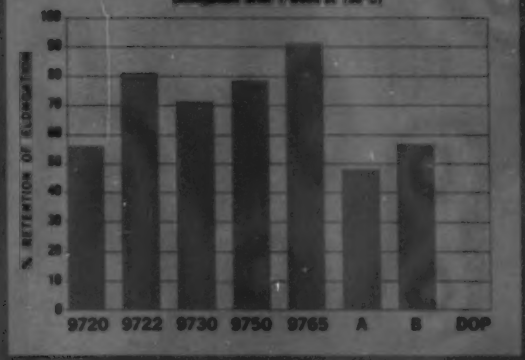


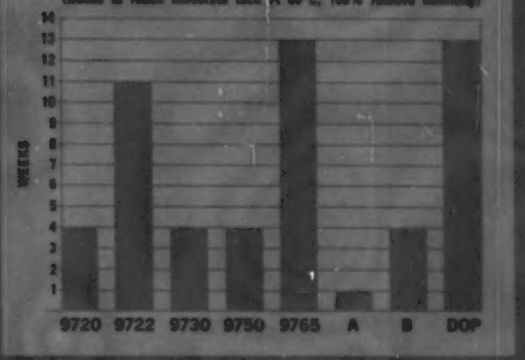
HEXANE EXTRACTION
(1 day at 25°C)



VOLATILITY

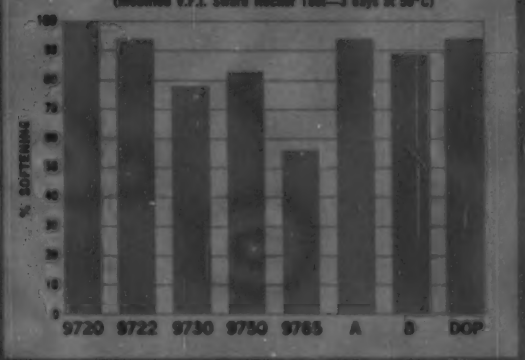


HUMIDITY AGING
(weeks to reach moderate tack at 60°C, 100% relative humidity)

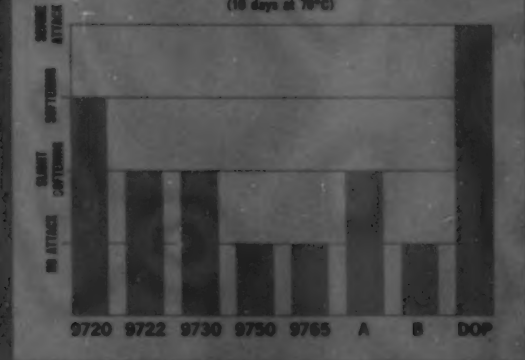


HEAT STABILITY AT 350°F
(mid-line indicates first evidence of failure)

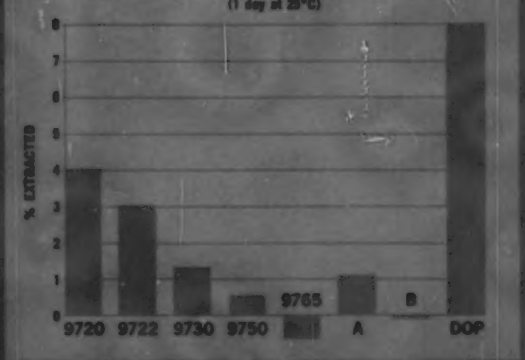
NITROCELLULOSE MIGRATION
(modified V.F.I. Sward Rocker Test—3 days at 50°C)



POLYSTYRENE MIGRATION
(10 days at 70°C)



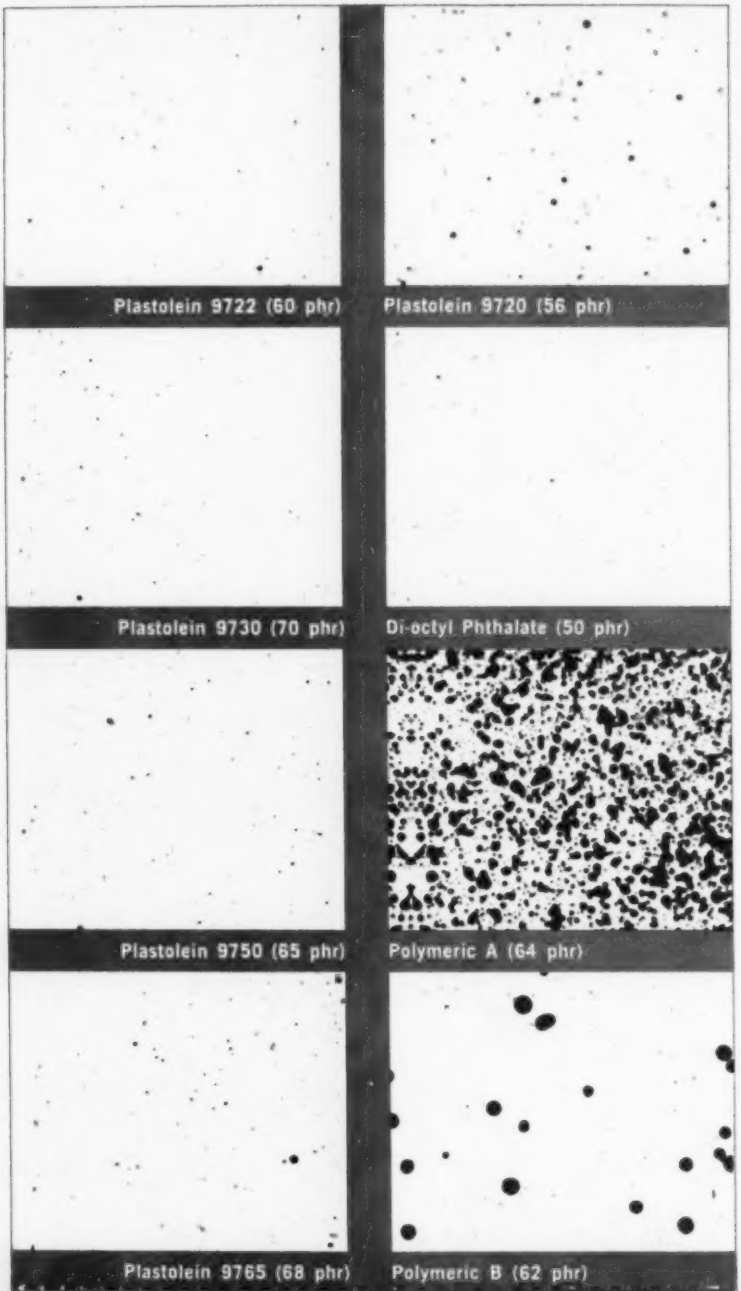
STODDARD SOLVENT EXTRACTION
(1 day at 25°C)



See Florida aging results on the back of this folder

COMPARE

new Plastolein Polymerics with two leading competitors after 600 hours of Florida sun


Plastolein 9722 (60 phr)
Plastolein 9720 (56 phr)
Plastolein 9730 (70 phr)
Di-octyl Phthalate (50 phr)
Plastolein 9750 (65 phr)
Polymeric A (64 phr)
Plastolein 9765 (68 phr)
Polymeric B (62 phr)

All tests performed by the South Florida Test Service. Formulation of all test samples was as follows:

Geon 101 EP	100 parts
Stabilizer	3 parts
Plastolein 9232 Epoxy	4 parts
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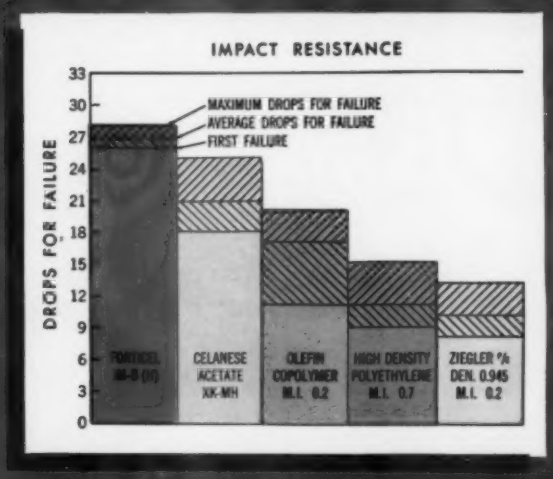

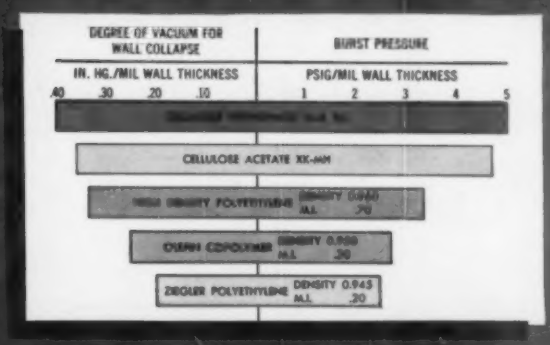

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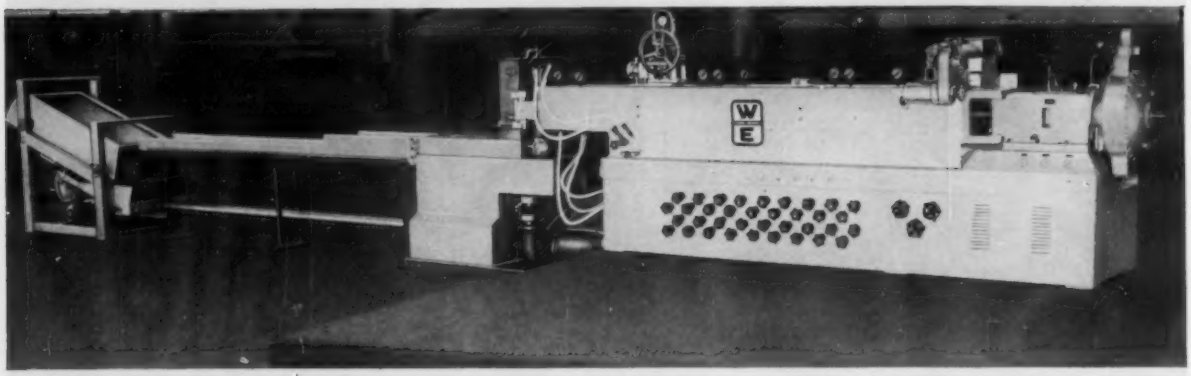

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PLASTICS TECHNOLOGY
THE MAGAZINE OF APPLIED ENGINEERING

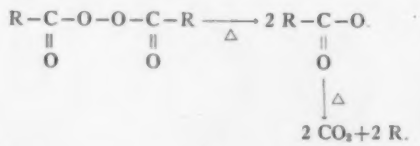
New way to extend polyester pot-life

Complex reinforced plastic laminates require both a long pot-life and a short gel period—neither of which is available (in combination) with conventional peroxide curing systems. By adding such ultraviolet sensitizers as benzoin, benzil, or Garalyst, the two requirements are met. Curing can then be effected with artificial ultraviolet radiation or direct sunlight, at 0° C. or at 25° C. Physical properties compare favorably to conventionally fabricated laminates.—Editor.

J. KAMINETSKY,* N. FRIED,** and R. R. WINANS**

Unsaturated polyester resins containing styrene as a cross-linking agent are generally copolymerized to form thermosetting materials by an addition reaction initiated by free radicals. These free radicals may be generated in a number of ways. Commercially, two main systems are employed.

THERMAL SYSTEM. A heat sensitive peroxide initiator such as benzoyl peroxide is incorporated into a polyester resin and the mixture is subjected to elevated temperatures. Free radical formation occurs as typified in the following formula:



ROOM TEMPERATURE CURING SYSTEM. A peroxide catalyst (e.g. methyl ethyl ketone peroxide) is incorporated into a polyester resin, together with an accelerator (cobalt naphthenate) which will induce free radical formation at room temperature. Free radicals are produced from the peroxide without external heat. The reaction is exothermic, with enough internal heat being generated to advance polymerization.

Although both systems possess many advantages which warrant their widespread application, there are some areas in which neither can be used effectively. The relatively short pot life and unpredictability of room temperature curing systems may constitute undesirable limitations in the fabrication of large reinforced plastic structures. Because of size, the use of a heat curing system, which would offer a much longer working life, may be impractical. The fabrication of a large section requires a long pot life (for lay up handling) combined with a short gel period as soon as the complex layup

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is completed. These two requirements cannot be achieved easily with either of the systems described above.

In view of these limitations, the Naval Material Laboratory, under the sponsorship of the Bureau of Ships, undertook to develop alternative procedures. Although catalytic systems have been proposed which induce polymerization by an ionic rather than a free radical mechanism, systems of this type are particularly difficult to control and have limitations similar to those discussed above. There remains the possibility of developing a process wherein free radicals are produced by radiant energy, such as ultra-violet light. The feasibility of this technique is demonstrated by energy considerations. The energy associated with light of a given frequency is represented by the following relationship:

$$E = hv$$

where v is frequency and h is Planck's constant. This relationship may also be expressed in the form:

$$E \text{ (cal/mole)} = \frac{2.8579 \times 10^8}{\text{wave length (Angstroms)}}$$

Thus, for example, at a wave length of 3000 Angstroms, the energy would be 95k cal/mole, which is in the range of the bonding energies of certain sensitizing agents. It could, theoretically, induce decomposition of these materials to free radicals. In practice, a number of such ultra-violet sensitive materials have been found, some of which do not produce free radicals directly but may act as activating or energy transfer agents to induce radical formation in the unsaturated polyester chain or in the styrene molecule.

It should be noted that extended ultra-violet exposure will cause gelation of many commercial unsaturated styrene-based resins directly, without the addition of any catalyst or sensitizer. Furthermore, the formation of free radicals from many of the organic peroxides can be accelerated to a greater or lesser extent by exposure to ultra-violet radiation. However, these processes are not generally suitable for commercial use because of poor control and because excessive irradiation would be required. The function of the sensitizer is to provide a system which can be controlled and caused to gel and cure under practical conditions.

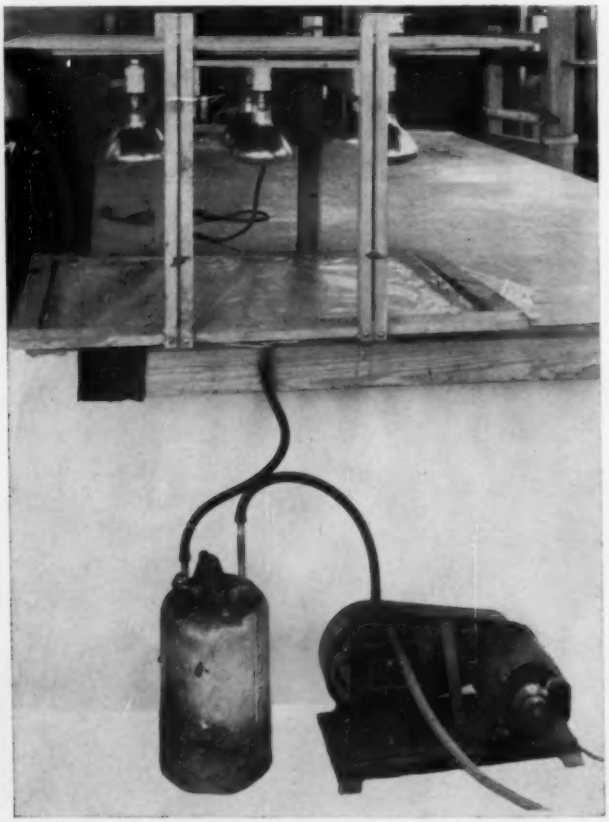
Lewis and Matheson (1)#, have reported on the use of biacetyl,

$$CH_3-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-CH_3$$

as a sensitizer in the polymerization of vinyl acetate and of styrene under ultra-violet radiation. This sensitizer has also been used in ultra-violet polymerization of methacrylic acid in aqueous solution (2) and methyl acrylate (3). The initial radical formation occurs in the range of 3,600 Angstrons as follows:

$$CH_3-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-CH_3 \longrightarrow 2\ CH_3\ \overset{\overset{O}{\|}}{C}.$$

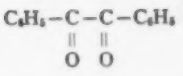
Numbers in parentheses refer to bibliography at end of article.



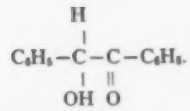
Ultra-violet lamps used in the fabrication of test panels.

Several other ketonic systems are also mentioned in the literature (4). A number of investigators have reported on the use of Azo compounds, such as 2-azo-bis-isobutyronitrile as sensitizing agents for vinyl addition reactions energized by ultra-violet radiation (1,2,3,5,6). The photochemical decomposition of peroxides is discussed by Tobolsky and Mesrobian (7) and has been studied by Jeu (4). Oster and his co-workers (8,9,10) as well as others (2,4) have investigated the use of dyes as sensitizing agents for photopolymerization. Benzil and benzolin have also received the attention of investigators (2). Among the other compounds investigated for effectiveness as sensitizers are: alkyl iodides (11), naphthols, chlorinated naphthalene and phenanthrene, di and persulfides, sulfones, thiuramsulfides, sulfonyl chloride derivatives, and uranyl nitrate—all of which are mentioned in the patent literature.

An analysis of the literature on photopolymerization processes, together with preliminary studies at the Laboratory, indicated that the most practicable sensitizing agents for styrene-based unsaturated polyester systems would be benzil



and benzoin



In addition, a commercial catalyst, Geralyst (12)## (a combination of peroxides and an ultra-violet sensitizer), also appeared promising and was included in the study.

Initial experiments were performed on sensitized polyester resins using ultra-violet radiation as an energy source. Results showed that stable, sensitized polyesters with a long pot-life could be prepared which would gel and cure rapidly upon irradiation. In view of these findings, the projected comprehensive program on the development of practical laminating processes was undertaken.

Objective

The object of our investigation was to study the photo-initiation process and to develop suitably sensi-

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TABLE I
DETAILS OF FABRICATION OF GLASS REINFORCED POLYESTER PANELS[a]

Panel	Reinforcement (No. of Plies)	Catalyst (%)	Ultra-Violet Source	Distance of Lamps From Panel	Gel Time (minutes)	Maximum Exotherm Developed	Irradiation Time (minutes)	Nominal Thickness (inches)
1	Style 1000 cloth, Volan A finish, (10 plies)	1.0% DDM 0.5% Cobalt	None	—	50	24° C	—	1/8
2	Style 1000 cloth, Volan A finish, (10 plies)	Garalyst (5%)	R-S Sunlamps	27"	10-12	38° C	30	1/8
3	Style 1000 cloth, Volan A finish, (10 plies)	Garalyst (5%)	R-S Sunlamps	11½"	5-6	47° C	30	1/8
4	Style 1000 cloth, Volan A finish, (10 plies)	Garalyst (5%)	R-S Sunlamps	27"	20	42.5° C	60	1/8
5	Style 1000 cloth, Volan A finish, (10 plies)	Benzil (5%)	R-S Sunlamps	12"	90	64° C	150	1/8
6	Style 1000 cloth, Volan A finish, (10 plies)	Benzoin (5%)	R-S Sunlamps	27"	15	48° C	90	1/8
8	Style 1000 cloth, Volan A finish, (38 plies)	1.0% DDM 0.5% Cobalt	None	—	40	48° C	—	1/2
12	Style 1000 cloth, Volan A finish, (38 plies)	Garalyst-(3%) DDM-(0.2%) Cobalt-(0.08%)	R-S Sunlamps	12"	15	90° C	120	1/2
16[b]	Style 1000 cloth, Volan A finish, (10 plies)	Garalyst (5%)	R-S Sunlamps	27"	35	16° C	85	1/8
18	Style 1000 cloth, Volan A finish, (38 plies)	Garalyst (5%)	R-S Sunlamps	12"	10	80° C	120	1/2
19	Style 1000 cloth, Volan A finish, (10 plies)	Garalyst (5%)	Sunlight	—	15	43° C	170	1/8

a—All panels were fabricated with the same general purpose polyester resin by vacuum bag technique.
b—Fabricated at 0°C; all other panels were fabricated at room temperature (25°C).

TABLE 2
RESUME OF PROPERTIES

Property	Conditioning	Unit of Value	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 8	Panel 12	Panel 16	Panel 18	Panel 19
Flexural Strength, flatwise, cut lengthwise	face up[a]	psi. x 10^{-3}											
	Initial		42.6	38.6	34.3	41.4	19.0	38.1	38.5	46.3	25.9	38.7	46.6
	D-2/100+D-1/23		41.6	38.8	35.4	40.2	21.4	36.2	38.0	41.8	34.3	33.9	39.1
	E-24/104+C-2/23/50		49.3	50.2	47.4	48.9	36.4	48.8	43.1	46.5	46.9	42.8	49.7
	face down[a]												
	Initial		44.5	24.6	23.6	36.2	32.4	26.2	43.0	41.4	14.2	28.4	45.3
	E-24/104+C-2/23/50		——	——	48.2	50.6	43.1	43.4	46.9	46.4	46.0	37.2	47.7
Flexural Modulus, flatwise, cut lengthwise	face up	psi. x 10^{-6}											
	Initial		3.02	2.33	2.62	2.53	2.57	3.02	2.84	3.21	1.61	2.85	2.97
	D-2/100+D-1/23		2.79	2.57	2.57	2.31	1.75	2.26	2.81	2.93	1.98	2.82	2.36
	E-24/104+C-2/23/50		3.20	3.05	3.21	2.95	3.01	3.24	3.27	3.24	2.66	3.13	3.04
	face down												
	Initial		3.04	2.38	2.34	2.67	2.66	2.48	2.94	3.08	1.29	2.74	2.96
	E-24/104+C-2/23/50		——	——	3.00	2.99	2.91	2.99	3.01	3.13	2.77	3.05	2.86
Tensile Strength, cut lengthwise	Initial	psi. x 10^{-3}	40.3	40.0	41.1	36.5	30.2	32.3	36.9	39.7	25.2	36.6	37.2
Tensile Modulus, cut lengthwise	Initial	psi. x 10^{-6}	2.69	2.39	2.57	2.39	2.12	2.13	2.52	2.47	1.98	2.17	2.21
Compressive Strength, edgewise, cut lengthwise	Initial	psi. x 10^{-3}	24.0	18.2	14.5	17.5	15.3	15.5	29.3	29.8	12.4	23.2	23.7
	D-2/100+D-1/23		14.3	15.1	14.0	16.9	13.7	14.1	29.4	28.9	11.9	17.9	14.7
	E-24/104+C-2/23/50		29.5	21.5	20.8	23.7	21.8	23.6	35.1	33.9	22.0	25.7	26.4
Shear Strength, (Johnson) cut lengthwise	Initial	psi. x 10^{-3}	16.5	15.4	15.0	15.8	16.9	15.0	15.3	17.4	13.1	14.1	15.9
Resin Content	Initial	per cent	43.5	39.0	35.2	42.2	47.2	48.4	45.5	41.9	46.4	43.6	46.9
Specific Gravity	Initial	——	1.76	1.79	1.83	1.75	1.70	1.68	1.71	1.75	1.68	1.67	1.69
Void Content	Initial	per cent	0.37	0.53	1.24	0.36	0.00	0.11	0.74	0.72	1.63	4.40	0.44
Barcol Hardness	face up	——											
	Initial		54	54	51	48	43	47	53	53	46	54	49
	E-24/104+C-2/23/50		——	——	61	50	45	47	53	53	54	54	48
	face down												
	Initial		48	11	36	42	55	22	38	45	0	37	43
	E-24/104+C-2/23/50		——	——	54	48	59	48	42	50	36	48	46
Inter-Laminar Shear, cut lengthwise	Initial	psi.	2,068	2,055	1,819	2,105	1,510	1,369	1,749	1,804	1,170	1,610	1,600
Thickness (range)	Initial	inches	0.115-0.134	0.110-0.124	0.105-0.112	0.118-0.141	0.133-0.158	0.141-0.152	0.518-0.563	0.484-0.518	0.135-0.143	0.495-0.522	0.135-0.146

D = Immersion (D-2/100 = Immersion for 2 hours at 100°C).
E = Heat (E-24/100 = Heated for 24 hours at 100°C).
C = Humidity (C-23/50 = 2 hours at 23°C, 50% R.H.).

a—face up—Load applied to irradiated surface.
face down—Load applied to surface adjacent to mold.

tized, unsaturated polyester resin systems which could be used for the fabrication of glass reinforced structural laminates by means of ultra-violet radiation. Such resin systems would provide extended pot-life and quick-gelling characteristics upon irradiation. Is was also desired to develop information on physical properties of structural glass-reinforced materials fabricated with such resin systems.

Materials

In conducting these investigations, a number of glass reinforced polyester panels were fabricated with variations in catalyst and sensitizing system, thickness, and degree (intensity and duration) of ultra-violet radiation. For purposes of standardization and comparison, all panels were fabricated using the same resin and reinforcement. Each panel consisted of the same general-purpose polyester resin, catalyst (or sensitizer), and a number of plies of Style 1000 cloth, Volan A finish (10 plies for the ⅛-inch thick panels and 38 plies for the ½-inch thick panels).

A detailed description of the processing of each of the panels evaluated, is presented in Table 1. A standardized vacuum bag (0.003-inch polyvinyl alcohol film) technique was used in each case. As indicated, all panels were fabricated at room temperature (25°C) with the exception of Panel 16, which was fabricated at 0°C and Panel 19 which was fabricated in sunlight, out-of-doors, at an ambient temperature of 77°F. All panels measured 26 by 16 inches, producing enough material for all test specimens of a given laminate to be taken from one test panel.

To determine the maximum temperature developed, a thermocouple was placed in the center of each panel lay-up (between the 5th and 6th layers for the ⅛-inch thick materials and between the 19th and 20th layers for the ½-inch thick materials). The exotherm temperatures together with other pertinent information, are listed in Table 1.

Six General Electric ultra-violet R-S Sunlamps (275 W, 120 V) were used to provide radiation, and were mounted on a frame directly over the panel. For comparison purposes, controlled panels in the same thicknesses, were fabricated using a conventional DDM-Cobalt system at room temperature (no irradiation).

Test methods

All panels were tested from two to four weeks after fabrication. During the interim period, they were conditioned in a standard laboratory environment of 23°C and 50% R.H. Physical properties of these laminates were determined in accordance with the methods outlined in Military Specifications MIL-P-17549 and L-P-406b on appropriate size specimens, cut in the lengthwise direction. Edgewise compressive strength properties of the ⅛-inch thick materials were determined in a supporting jig.

Test results

Results of tests conducted on the various panels are given in Table 2. The values presented are averages of five determinations for each property value, with the exception of Barcol Hardness where ten determinations were made for each value listed.

Determinations of flexural characteristics were made with load applied to the surface adjacent to the mold (bottom surface), as well as the irradiated surface (top surface). Barcol Hardness determinations were also performed on both surfaces. This was done to determine the effectiveness of ultra-violet radiation in inducing polymerization through a thickness of resin-impregnated glass cloth laminae.

Although preliminary experiments were performed using an ultra-violet source of 3,650 Angstroms (black light), the panels evaluated in this report were all fabricated, as indicated in Table 1, with R-S Sunlamps, which radiate principally at 2,967 Angstroms. The R-S Sunlamps were selected for convenience and ease in handling, since they do not require any auxiliary transformers or ballast, and have a standard medium base, thus making them commercially suitable.

In addition to the data on physical properties in Table 2, the following pertinent information was developed:

1. Commercially used vacuum bag materials, such as polyvinyl alcohol (0.003-inch) or Mylar film (0.001-inch) did not inhibit the action of ultra-violet radiation with respect to polyester resin at 2,967 or at 3,650 Angstroms.
2. The addition of small amounts of Cab-O-Sil (3%) or pigment (3%), to sensitized resin, did not prevent ultra-violet penetration and produced a satisfactory reinforced glass-resin panel of ½-inch thickness.
3. To determine stability under practical shop conditions, pot-life studies were conducted on sensitized resin at room and at elevated temperatures with the following results:

Pot Life of Sensitized Resin in the Dark
(100 grams of Resin + Sensitizer at 73°F. 50% R.H.)

Polyester Resin +5% Garalyst	14 days—no change 28 days—thin layer of gelled resin 70 days—half of container gelled, tacky 150 days—90% of container gelled, tacky
Polyester Resin +5% Benzoin	4 days—⅓ of container gelled, tacky 14 days—same 28 days—40% of container gelled, tacky 70 days—60% of container gelled, tacky 150 days—80% of container gelled, tacky
Polyester Resin +5% Benzil	14 days—no change 28 days—no formation of any gelled material, more viscous 70 days—same 150 days—no formation of any gelled material, yellow color more pronounced, more viscous

Pot Life of Sensitized Resin at Elevated Temperature
(100 grams of Resin + Sensitizer for 1 hour at 167°F)

Polyester Resin +5% Garalyst	gelled completely, set up hard, not tacky
Polyester Resin +5% Benzoin	gelled completely, set up tacky
Polyester Resin +5% Benzil	no change, still liquid

Hand Lay-up

Property	Mat	Fabric
Specific Gravity	1.4-1.7	1.6-2.0
Tensile Strength, psi.	10,000-20,000	30,000-50,000
Tensile Modulus, psi.	$0.8x10^6$-$1.8x10^6$	$1.5x10^6$-$4.5x10^6$
Compressive Strength, psi.	15,000-25,000	30,000-56,000
Flexural Strength, psi.	20,000-40,000	45,000-75,000
Flexural Modulus, psi.	$1.2x10^6$-$1.8x10^6$	$2x10^6$-$4x10^6$
Impact Strength (ft. lbs./in.)	5-25	20-30
Hardness (Barcol)	40-80	45-85
Moisture Pick-up (%)	.05-1.0	.05-1.0
Burning Rate (in./minute)	Slow to Self-Extinguishing	
Heat Resistance (Continuous ° F.)	150-350	150-350
Effects of Acids and Alkalis	Fair to Excellent	
Effect of Solvents	Good to Excellent	
Machining Qualities	Fair to Good, Use Carbide or Diamond Tools	
Dielectric Constant 1 Meg./ 9360 Meg.	—	4-4.6/4.1-4.5
Loss Tangent 1 Meg./ 9360 Meg.	—	.01-.06/.01-.03
Resin Content, %	60-70	45-55

Filament Winding

Property	
Specific Gravity	1.7-1.9
Tensile Strength, psi.	80,000-250,000
Tensile Modulus, psi.	Up to $7x10^6$
Compressive Strength, psi.	50,000-75,000
Flexural Strength, psi.	100,000-200,000
Flexural Modulus, psi.	—
Impact Strength (ft. lbs./in.)	50-70 (Unnotched)
Hardness	—
Moisture Pick-up (%)	0.1-0.5
Burning Rate (in./minute)	Slow to Self Extinguishing
Heat Resistance (Continuous ° F.)	Up to 500
Effect of Acids and Alkalis	Fair to Excellent
Effect of Solvents	Good to Excellent
Machining Qualities	Poor to Fair. Should be used as molded.
Dielectric Constant 1 Meg./ 9360 Meg.	—/4.1-4.5
Resin Content, %	15-25

Preform & Mat

Property	
Specific Gravity	1.5-1.6
Tensile Strength, psi.	10,000-24,000
Tensile Modulus, psi.	$0.8x10^6$-$1.8x10^6$
Compressive Strength, psi.	18,000-30,000
Flexural Strength, psi.	25,000-45,000
Flexural Modulus, psi.	$1.25x10^6$-$1.8x10^6$
Impact Strength (ft. lbs./in.)	13-25 Unnotched
Hardness (Barcol)	40-80
Moisture Pick-up (%)	0.1-1.0
Burning Rate (in./minute)	Slow to Self Extinguishing
Heat Resistance (Continuous ° F.)	150-400
Effects of Acids and Alkalis	Fair to Excellent
Effect of Solvents	Good to Excellent
Machining Qualities	Good with Carbide or Diamond Tools
Dielectric Constant 60 cps/1000 cps	4.5-6/3-4
Dielectric Strength (Volts per Mil) unfilled/filled resin	400/500-700
Resin Content, %	50

Premix

Property	
Specific Gravity	1.4-2.3
Tensile Strength, psi.	5000-10,000
Tensile Modulus, psi.	$1.5x10^6$-$2.x10^6$
Compressive Strength, psi.	13,000-27,000
Flexural Strength, psi.	6000-26,000
Flexural Modulus, psi.	$1.5x10^6$-$2.5x10^6$
Impact Strength (ft. lbs./in.)	1-25
Hardness (Barcol)	60-90
Moisture Pick-up (%)	.05-0.2
Burning Rate (in./minute)	.35-.75 to Self Extinguishing
Heat Resistance (Continuous ° F.)	250-450
Effect of Acids and Alkalis	Fair to Excellent
Effect of Solvents	Good to Excellent
Machining Qualities	Good with Carbide or Diamond Tools
Dielectric Constant 1 Meg./ 9360 Meg.	4-6/
Dielectric Strength (Volts per Mil)	200-400
Arc Resistance (Seconds)	160-190
Volume Resistivity (Ohm-Cm.)	$1x10^{12}$-$1x10^{13}$
Surface Resistivity (Ohm-Cm.)	$2x10^{11}$-$1x10^{12}$
Volume Resistance (Megohms)	1-$2x10^5$
Surface Resistance (Megohms)	$7x10^3$-$4x10^4$
Resin Content, %	20-35

Spray-up

Property	
Specific Gravity	1.4-1.6
Tensile Strength, psi.	9000-18,000
Tensile Modulus, psi.	0.8×10^6-1.8×10^6
Compressive Strength, psi.	15,000-25,000
Flexural Strength, psi.	16,000-28,000
Flexural Modulus, psi.	1×10^6-1.2×10^6
Impact Strength (ft. lbs./in.)	5-15
Hardness (Barcol)	40-80
Moisture Pick-up (%)	.05-1.0
Burning Rate (in./minute)	Slow to Self Extinguishing
Heat Resistance (Continuous ° F.)	150-350
Effects of Acids and Alkalis	Fair to Excellent
Effect of Solvents	Good to Excellent
Machining Qualities	Fair, Use Carbide or Diamond Tools
Resin Content, %	60-70

Pre-Preg

Property	
Specific Gravity	1.8-1.9
Tensile Strength, psi.	40,000-55,000
Tensile Modulus, psi.	$1.5x10^6$-$4.5x10^6$
Compressive Strength, psi.	35,000-60,000
Flexural Strength, psi.	50,000-80,000
Flexural Modulus, psi.	$2.5x10^6$-$4x10^6$
Impact Strength (ft. lbs./in.)	20-30
Hardness (Barcol)	50-85
Moisture Pick-up (%)	0.1-0.5
Burning Rate (in./minute)	Slow to Self Extinguishing
Heat Resistance (Continuous ° F.)	Up to 500
Effect of Acids and Alkalis	Fair to Excellent
Effect of Solvents	Good to Excellent
Machining Qualities	Fair with Carbide or Diamond Tools
Dielectric Constant 1 Meg./ 9360 Meg.	4-4.6/4.1-4.5
Loss Tangent 1 Meg./9360 Meg.	.01-.06/.01-.03
Resin Content, %	35-50

NOTE: Data applies to glass fabric reinforced materials.

4. In order to determine whether additional U.V. radiation had any deleterious effect on a properly cured laminate, a ½-inch thick panel (Panel 12) was subjected to further radiation. Results, which are given below, indicated no adverse effect.

Property	Initial	Additional U.V. Radiation on the Top Surface (12-in. from Lamps) After 3 hours	After 6 hours
Flexural Strength, (face up) flatwise, cut lengthwise, psi.	46,300	45,800	46,000
Flexural Modulus, (face up) flatwise, cut lengthwise, psi.	3.21×10^6	3.26×10^6	3.41×10^6
Compressive Strength, edgewise, cut lengthwise, psi.	29,800	31,800	31,200
Shear Strength, (Johnson) cut lengthwise, psi.	17,400	17,200	17,700
Barcol Hardness (face up)	53	57	57
(face down)	45	47	49

5. Examination of Table 2 indicates the possibility that panels made with limited U.V. radiation may not have reached optimum cure. For this reason, a typical ⅛-inch panel (No. 4) was exposed to additional radiation as shown below. This resulted in a marked increase in physical properties and essentially complete cure.

Property	Initial	Additional U.V. Radiation on the Top Surface (12-in. from Lamps) After 3 hours	After 6 hours
Flexural Strength, (face up) flatwise, cut lengthwise, psi.	41,400	49,200	50,800
Flexural Modulus, (face up) flatwise, cut lengthwise, psi.	2.53×10^6	2.90×10^6	3.21×10^6
Compressive Strength, edgewise, cut lengthwise, psi.	17,500	21,200	21,800
Shear Strength, cut lengthwise, psi.	15,800	17,200	17,300
Barcol Hardness (face up)	48	54	54
(face down)	42	47	49

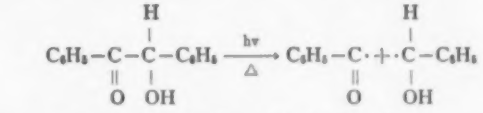
6. The effect of undercure was particularly apparent in the ⅛-inch thick Panel 16, which had been fabricated at 0°C. Here again, additional U.V. radiation (at room temperature) produced a marked increase in physical properties, as indicated below:

Property	Initial Face Up	Initial Face Down	2 Hours Additional U.V. Radiation on the Bottom Surface (12-in. from Lamps) Face Up	Face Down
Flexural Strength flatwise, cut lengthwise, psi.	25,900	14,200	40,600	38,500
Flexural Modulus flatwise, cut lengthwise, psi.	1.61×10^6	1.29×10^6	2.69×10^6	2.64×10^6
Barcol Hardness	46	0	47	34

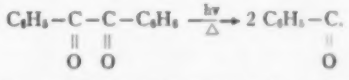
Interpretation of results

By the proper selection and use of a sensitizing agent, and adjustment of intensity and time of exposure, glass reinforced polyester laminates can be fabricated with ultra-violet radiation. They will compare favorably in physical properties with laminates made with conventional peroxide curing systems.

Benzil is a considerably more stable sensitizer than benzoin under the conditions employed in the present investigation. The initial reaction for benzoin.



proceeds more rapidly than that for benzil,



under similar conditions. However, when a long pot-life is required at relatively high ambient temperatures, benzil might be indicated. Garalyst, in the same concentration as benzoin, proved equally effective as a sensitizer. Moreover, a laminate prepared with Garalyst showed more uniform cure (Panel 4) as compared with a similar panel made with benzoin (Panel 6).

Glass reinforced-polyester laminates (with sensitizers added) can be fabricated in a relatively short time by artificial ultra-violet radiation in the range of approximately 3,000 Angstroms, as well as in direct sunlight. The R-S Sunlamps used in these investigations emitted some heat which tended to accelerate the reaction. However, it was possible to fabricate a laminate at 0°C (Panel 16), indicating that the photochemical process can proceed at low temperatures. It is interesting to note that a conventional room temperature resin system (1.0% DDM and 0.5% Cobalt naphthenate accelerator) at 0°C, took 165 minutes to gel, whereas gelation of the sensitized resin in the glass reinforced panel at this temperature (in contact with a cold aluminum plate) took 35 minutes under moderate U.V. radiation.

Experience has shown that conventional room temperature-cured glass reinforced laminates may not reach optimum cure for a considerable period of time. To accelerate this process, laminates are frequently post cured (e.g. E-24/100).† Similarly, an undercured panel fabricated with a U.V. sensitizer system may be fully cured either by additional U.V. exposure or by heat.

By proper adjustment of radiation intensity, a U.V. sensitized polyester resin can be caused to gel much more rapidly than a conventional room temperature catalyzed system (e.g. 1% DDM, 0.5% Cobalt naphthenate accelerator). Although the latter system can be speeded up by increasing the amount of catalyst or, more

† Heated 24 hrs. at 100°C.

particularly, the amount of accelerator, such systems are very difficult to control and may produce excessive exotherm which can result in poor laminates.

It should be noted, however, that the conventional peroxide system tends to gel more uniformly throughout the resin mass. In the U.V. curing system, the resin at the surface gels quickly and the substrate resin gels progressively, so that the resin at the bottom may not be fully cured unless radiation continues. Just as excessively rapid polymerization may be deleterious in a conventional room temperature peroxide curing system, there is evidence that similar effects may occur if a U.V. sensitized system is polymerized too rapidly. It follows irradiation at a somewhat lower intensity for a longer period of time is preferable to very intense radiation for a short time period.

Advantages

From a practical viewpoint, the principal advantage in using an ultra-violet curing system lies in its handling characteristics. As long as the sensitized resin is not exposed to an ultra-violet source, polymerization will not occur at room temperature within a few days. This would permit laying up a complex structure without any danger of the resin gelling before the entire assembly is completed. Subsequent to the lay-up, which may take a number of hours (or even days), exposure to an ultra-violet source for a relatively short time will cause polymerization.

It is possible to sensitize a large amount of resin at one time, store it in a drum or transport it in an unpolymerized condition, and use the mixture as needed. This eliminates the necessity for weighing each batch carefully to obtain the proper resin-catalyst ratio. The sensitized resin may then be polymerized quickly by exposure to an ultra-violet source. The intensity and time of radiation must be increased with increasing structural thickness. Laminates ½-inch in thickness have been fabricated at the Laboratory by proper adjustment of total radiation.

There are other major advantages in using ultra-violet sensitized polyester resins. Laminates can be fabricated at low temperatures within a reasonable time, and reinforced polyester structures can be produced in sunlight with consequent cost savings. Indoors, the use of a U.V. curing system eliminates the necessity for large ovens, which again reduces overall costs.

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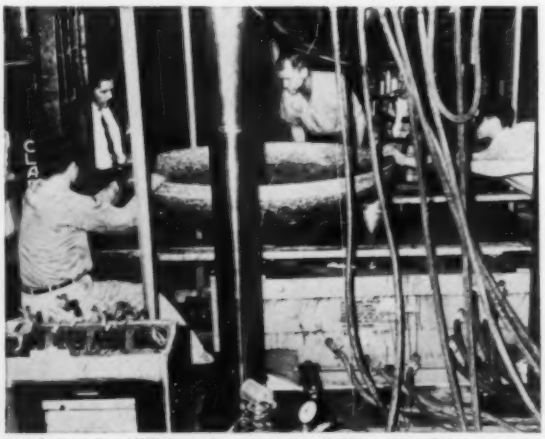
—THE END

Compression molding insulates missile

A 400-pound, 60-inch diameter reinforced plastic plate, claimed to be the largest and heaviest compression molded part to date, is being produced for the first-stage Air Force Minuteman ICBM by Dumont Manufacturing Corp., San Rafael, Calif. Molded in one piece and in a single press shot, the 14-inch deep part is the rear closure insulation for the engine.

As such, the part protects the steel structural casing from damage by burning propellant. This ablative part uses up heat by burning and charring on the outside, while protecting the inside from extremes of temperature. The plate will be subjected to temperatures greater than 5,000° F. at high pressures, but will insulate the steel casing for the life of motor firing. It will hold the internal temperature down to a maximum of 200° F.

Fabricated on a special press, the plate will consist of high temperature resistant phenolics reinforced with silica, asbestos, and graphite fibers, singly or in combinations. The 2,000-ton, steam-heated press, designed for production of large, reinforced plastics moldings,



Insulation for ICBM engine is removed from die after compression molding.

has an eight-foot stroke to accommodate a wide range of tooling and permit rapid die changes. Four independently controlled cylinders close the platen.

Although molding the part in one piece required development of a new press, the one piece molding is considered to be more reliable than a plate consisting of small sections bonded together. One tool molding also enabled overall economies and faster delivery dates.

—THE END

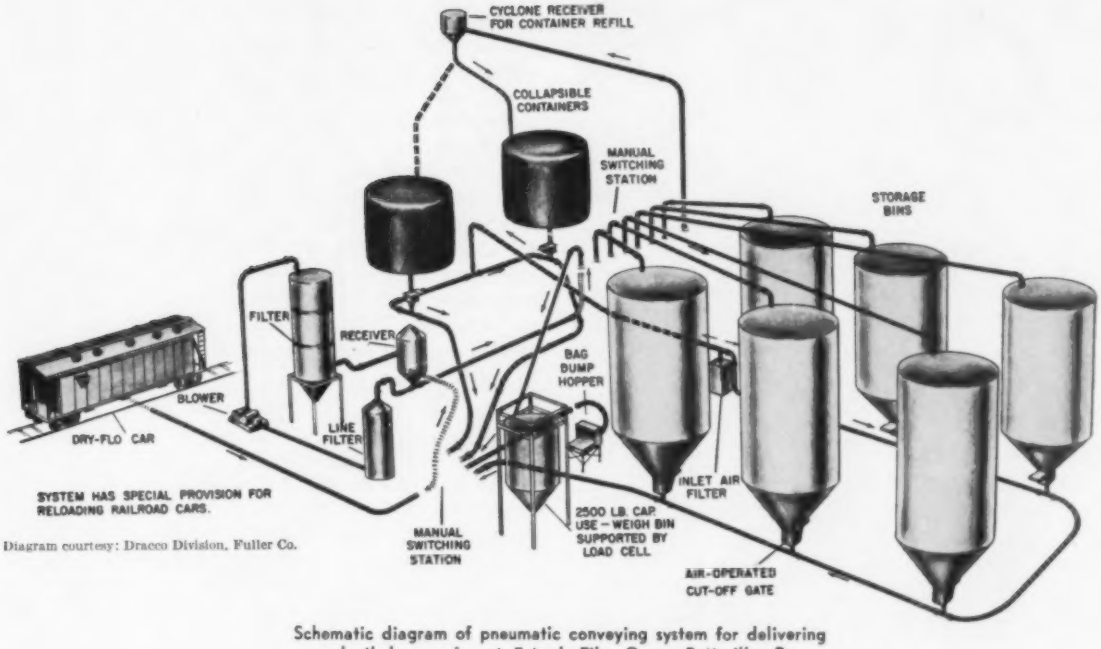


Diagram courtesy: Dracco Division, Fuller Co.

Schematic diagram of pneumatic conveying system for delivering polyethylene resins at Extrudo-Film Corp., Pottsville, Pa.

Pneumatic materials handling– a survey report

JEAN E. JELLINEK*

Many companies supply resins and fillers in railroad car lots at prices $0.0125 per pound below bulk cost. To process materials delivered in this manner, some sort of handling system is required.

By installing a pneumatic conveying system, the plastics processor can take advantage of substantial material price discounts, minimize resin contamination, and reduce labor expenditures. On the other hand, his volume may be insufficient or his consumption too diverse to make such a conveying system economically advisable or even practical.

Plastics engineers adapted the principle of pneumatic conveying from the grain industry which, at the end of the nineteenth century, began to utilize and direct a stream of air to carry a load to a specific destination. The first ingenious pneumatic installation transferred grain from a ship's hold to an adjacent plant constructed on a pontoon. A nozzle and pipeline sucked the grain to an elevated receiver, where it passed through an air lock for final gravity delivery. This simple process is the basis for contemporary air conveying systems. It can be incorporated in new construction or adapted to established facilities. At this time, pneumatic conveying systems are in successful operation in several plastics plants of varying sizes.

Basically, the function of any pneumatic conveying system is to transfer materials from one point to another. This is all the simplest system will do. As a pneumatic conveying system becomes more complex, however, it will convey material from several origins to several destinations, via separators, storage bins, and other equipment.

Material delivery

Best resin prices can be secured by arranging delivery in specially designed chemical railroad cars, collapsible containers, or hopper trucks. The Dry-Flo and Chemomatic cars are two which have been adapted to transport plastic materials without contamination. The Chemomatic, a product of American Car & Foundry division, ACF Industries, unloads by gravity only. In contrast, the 3,500-cubic foot Dry-Flo car is unloaded either by gravity or suction. Manufactured by

* Associate editor

Photo courtesy: Dracco Division, Fuller Co.

Battery of cradles holds polyethylene-filled collapsible containers at Western Electric Co.'s Omaha works. Arms adjust pneumatically to bags as they empty. An air lock at the base of each container feeds pellets into either of two aluminum conveying lines.

General American Transportation Corp., it has a capacity of approximately 100,000 pounds. Because of the triple-compartment construction, up to three different materials can be shipped in a single car. Of the three compartments, the center one has smaller capacity than the outer two. Ten hatches in the top of the car open for loading. Six unloading hoppers on the bottom, two for each compartment, have outlet valves within the body to protect the contents from contamination during unloading. For unloading, a vacuum tube at least six inches in diameter is fastened to the outlet. When material is unloaded at rates less than 10,000 pounds per hour, a suction lance is employed.

Sealdbin collapsible containers which accommodate about 10,000 pounds (based on the weight of polyolefin pellets) have been developed by U. S. Rubber Co. These rubber containers are transported in open barges, trucks, or railroad cars. They are transferred to loading or to storage by a lift truck. The resin discount, while substantial, is not usually as large with this method of delivery as it is with hopper cars.

Trucks have also been adapted for bulk handling. Specially designed to carry plastics and other chemicals, they are loaded and unloaded by suction or pressure. Typical is Sprout, Waldron & Co., Inc.'s pressurized bulk truck, which loads polyethylene pellets from hopper cars at 20 tons per hour and unloads the same material at 30 tons per hour. This truck accommodates vinyl powders as well. It might be recommended for large volume processors who can accommodate hopper car quantities, but who are not located on railroad sidings.

Both Dry-Flo cars and Sealdbins can be used for waterproof, contamination-free outdoor storage at the processing plant. They are supplied by the materials companies, who allow 14 days' free use of the cars, and 21 days' use of the containers. After this period, demurrage charges are $7.00 per day for the cars, and $1.00 per day per Sealdbin.

Although the savings with Dry-Flo cars are greater than those with Sealdbins, there are times when it is more advantageous to use the latter; such as when scheduling does not permit carload shipments, when the company does not have a railroad siding, where many types of resins must be on hand, or where quantity does not justify use of a Dry-Flo car. Special cradles must be installed, and a lift truck purchased, to use Sealdbins.

Cost considerations

The greater the variety of resins and grades used, the more complicated and expensive the system to handle them. Processors who see personal advantages in pneumatic conveying must consider more than volume in estimating the cost of a handling system. Remember, the cost of installation can run as high as 65% of equipment costs.

Suppose, however, you are processing a single formulation of polyethylene. According to U. S. Industrial Chemicals Co., your minimum consumption should be 15,000-20,000 pounds per week or 800,000-1,000,000 pounds per year. This would justify the installation of a simple system ($5,000-10,000) to convey the resin directly from railroad siding or Sealdbin cradle to the processing machine. Here the container or car would be used for storage, and would be unloaded at a rate of 500-2,000 pounds per hour. Use of more than one resin type would complicate the system and raise costs.

Extrudo-Film Corp., Pottsville, Pa., incorporated a pneumatic conveying system in its new plant. The system can be adapted to unload railroad cars, collapsible containers, or multiwall bags. The latter are used only when a minimal amount of resin is required. A stainless steel-lined flexible metal hose with an aluminum intake nozzle unloads the resin. Suction draws the pellets to a receiving station just outside the building. The receiving station line is coupled to any of eight distributor lines at a switching station just inside the building. Six of these lines lead to 45,000-pound capacity storage bins. The seventh leads to a weigh bin. The eighth is used when it becomes necessary to refill a car or container from the storage bins. Railroad cars are unloaded from the plant siding, near which have been placed two cradles for supporting Sealdbins. When it is necessary to use bag shipments, the system unloads from the bags which have been placed in a portable dump hopper.

At Chippewa Plastics Co., Chippewa Falls, Wis., a pneumatic system conveys four different polyethylene resins from hopper bottom cars to any of 12 storage silos. Western Electric Co.'s Omaha works has a system which selects, unloads, and distributes different colored polyethylene and PVC pellets to 61 coating sites at the rate of 2,225 pounds per hour.

Equipment and design

Equipment suppliers are developing more efficient and varied components in response to the ever increasing demands for pneumatic conveying. Basically, however, each system includes similar components: a blower, separator, feed valves, and piping.

A rotary piston, positive displacement blower is a major investment. With most plastic resins, the blower should have the horsepower necessary to maintain a pressure of five pounds throughout the length of the system. This pressure, either positive or negative, is sufficient to convey material at a rate of 90-110 feet per second. Speeds greater than 110 feet per second will cause much unnecessary abrasion of the piping walls. Resin will be lost and the resulting fines will contaminate the conveying air.

Material can be conveyed by negative (suction) or positive pressure, or a combination of the two. In the latter case, suction unloads the material and carries it up through the receiving station. After passing through an air lock, material is conveyed to destination by positive pressure. It is generally recommended that negative pressure be employed for conveying material from several sources to a single destination, and that positive pressure be used when the number of destinations exceeds the number of pick-up points.

Speed and distance of conveyance set the horsepower requirements of the blower. At Western Electric's Omaha plant, five-hp. blowers convey PVC. Although polyethylene is lighter (30 pounds per cubic foot vs. 50 pounds per cubic foot), it travels farther and therefore requires 15-hp. blowers. Blowers of 40 and 30 hp. are in use at Extrudo-Film and Chippewa, respectively.

The water ring pump is an alternative to the positive displacement blower for vacuum and pressure applications. A rotating ring formed by a liquid, usually water, seals the impeller chamber and compresses the gas. Thus, there is no contact between internal metal parts. This yields a saving in wear and in lubrication requirements.

The blower, then, is the heart of a pneumatic conveying system. At the delivery or receiving station, however, it becomes necessary to separate the load from the carrying medium. Material is to be transferred from one pressurized system into either a gravity flow or opposing pressure line. At these points, the two other essential components of the system come in: the separator and the air lock (feeder valve).

Either a cyclone or gravity separator may be employed, depending upon the degree of separation desired. For example, Fluor-Hartmann makes two versions of separators: fine air sifters and coarse air sifters. The former, which operate centrifugally, will sift particles 10-500 microns in size; the latter, gravity separators, sift particles 500 microns and up.

Material-laden air enters the cyclone or receiving station tangentially. As it hits the sides of the cone, it slows down, and the whirling pellets form a vortex with speeds decreasing as the circumference narrows. The cleansed gases rise to the exhaust at the top of the separator, where they can be vented to the outside of the building, or filtered and retained. The pellets may move on to storage, another conveying line, or another separator.

Fines are collected by a dust filter if the air is not to be released. To keep them in the system would present an explosion hazard. Further, when processing colored resins, fines have different color characteristics which will cause streaking. Usually, the quantity of fines is insufficient to make them worth saving. Fines may also be collected in a water bath. The air passes through a spray chamber and emerges uncontaminated. Since sludge recovery is difficult, a bag type filter is usually preferred.

Fines separation may be repeated at different points along the line. Even if purified at the receiving station, the conveying air must pass through another cyclone or series of cyclones when resin is delivered to process or storage.

A rotary (air-lock or star) feeder must be installed at points of change in pressure. In a suction-pressure

Photo courtesy: Buell Engineering Co., Inc.

Resin-laden air enters Buell cyclone through inlet at upper right. Pellets form a vortex as they whirl to the dust outlet in the base. Cleansed gas rises to exhaust at the top.

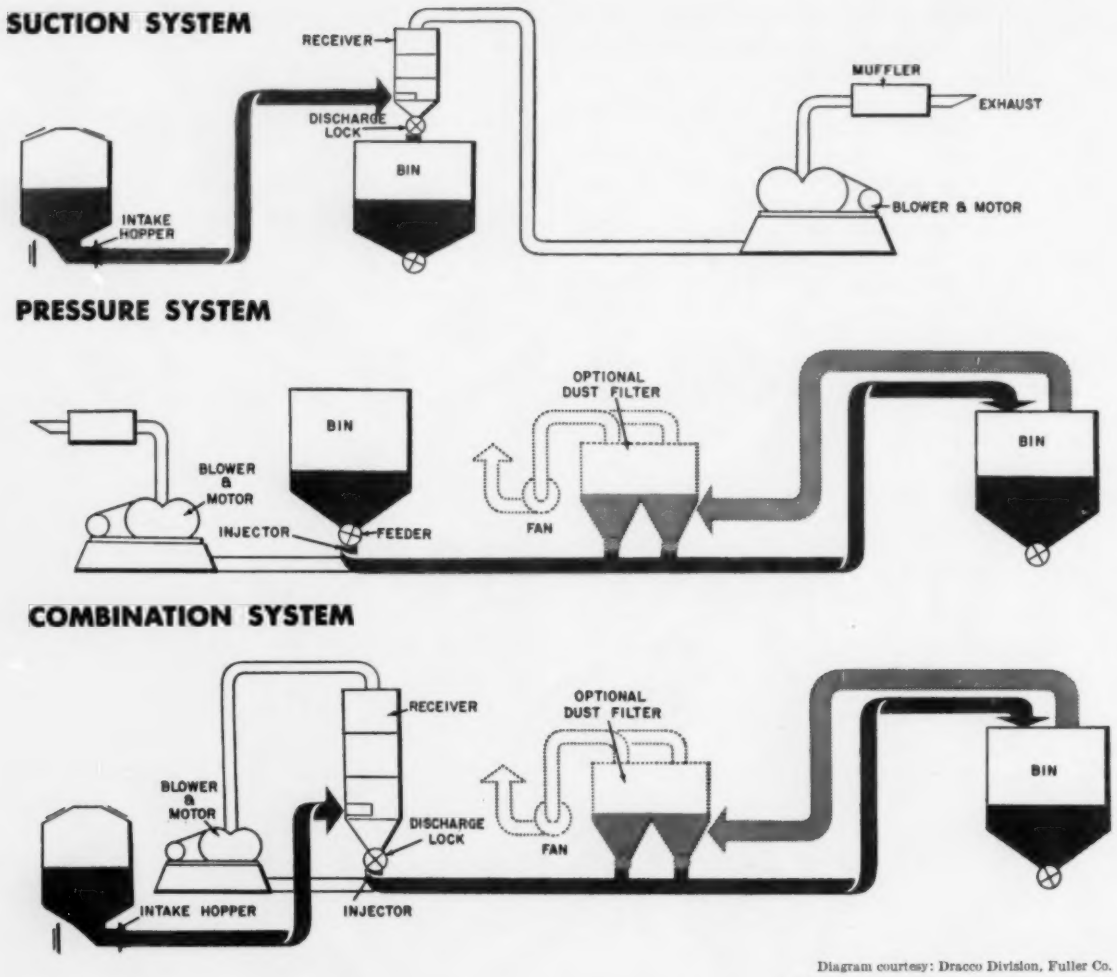


Diagram courtesy: Dracco Division, Fuller Co.

system, the feeder assures that the two opposing currents do not meet. The feeder also regulates the passage of solids from the cyclone separator into the bin, piping, or next point of destination. It is often used as a batching device with uniform weight materials.

When installed in storage bins which release material into a pressure line, feeders act as a seal. They can be fed by gravity or pressure. Drive depends upon the installation. One motor may drive a single feeder or a battery of feeders; or an integral motor can be supplied for each.

Recent feeder improvements have minimized earlier problems. For example, metal blade rotation often abrades the pellets, creating dust. This not only wastes material, but creates an explosion hazard as well. To prevent abrasion, feeder manufacturers coat metal blades with Hypalon, a synthetic, rubber-like material, or construct entire blades of this or similar compounds. Since normal rotation may trap pellets between the blade and wall, thus jamming the feeder, manufacturers have incorporated a scissors action into blade movement. This slices entrapped pellets which might hamper operation.

Piping for conveying plastics is most often aluminum, although stainless steel and aluminum-stainless steel combinations are often used. Piping is designed to prevent undue abrasion. Interior surfaces are joined without protrusions, either by welding or threadless coupling. Since rounded corners remove feathers from resin cubes, angles are extremely gentle. At points of change in direction, 25-30° angles cause the least abrasion. Bend radii should be as large as possible, at least 6-8 times larger than the pipe diameter. Piping most often is four inches in diameter, subject to user requirements.

Dracco has developed a patented system for preventing the formation of polyethylene and polypropylene ribbons (streamers) at bends. These ribbons collect on the inner piping walls and eventually break loose, traveling to the cyclone where they jam the feeder. By sandblasting the inner wall of the pipeline, Dracco roughens the line microscopically. Air collects in miniscule pockets and, when the pellets hit the wall, serves as a cushion to keep fines from adhering. At points where two or more lines diverge, manual, motor, or air-operated diverter valves can be installed to permit use of individual lines.

For certain small applications, a portable conveyor may be suitable. For example, Fuller Co.'s portable Airveyor is delivered ready for operation at the plant.

Material is picked up by vacuum and discharged under pressure. It passes through a cyclonic receiver, and a rotary valve reintroduces the material into a positive line. A second stage separator with filter media prevents material carry-over which might damage the blower.

Several alternatives are possible when purchasing a pneumatic conveying system. The simplest method is to purchase such a self-contained unit as described above. The Airveyor will handle up to 20 tons per hour. For more elaborate systems, the processor may engage an engineering firm which specializes in conveyance design, such as Dracco division of Fuller Co., or may engineer the system himself and purchase specified equipment. The large materials suppliers such as U.S.I. and Monsanto are now offering excellent counsel and assistance to processors interested in pneumatic conveying.

Three conveying systems

The following descriptions of pneumatic conveying installations will help to provide some indication of their function and utility. The first system unloads resin from transport and conveys it to storage. The second conveys resin directly from transportation to process; while the third conveys resin from transport to storage and then, after any desired period, to process.

At Chippewa Plastics, a suction-pressure Airstream conveyor system unloads four resins by suction. At a receiver inside the plant, a rotary lock feeds the resin through a pressure line to one of 12 silos. This is the end of the pneumatic system. Material falls into 500-pound capacity portable hoppers by gravity. These hoppers are then placed over floor level inlet pipes leading to extruders directly below for final handling.

With this system, a 120,000 pound car can be unloaded in about ten hours. Conveying air enters through inlet filters in the tops of the hopper cars. It is purified by a bag-type dust collector before entering the positive line.

In Western Electric's Omaha plant, resin travels directly from cradled Sealdbins to process. A rotary lock installed at the mouth of each Sealdbin feeds pellets into the conveying line. Three separate conveyor systems feed polyethylene from 12 Sealdbins containing up to 10 different colors of pellets to 42 wire extruders. Black polyethylene travels to six sheathing extruders by means of three more conveyors. PVC is conveyed from another delivery room to 13 switchboard wire extruders and two switchboard jacketing extruders. This extremely complex system, incorporating 11 conveyor units, can be adapted to unloading from hopper cars if this should become desirable.

A low level solids indicator in the hopper of each extruder controls resin delivery. A master control panel receives and checks the signal emitted by the indicator. If the lines are open and no other color is being fed, a diverter valve opens above the proper hopper, and the rotary valve feeds pellets until another signal from the hopper indicator is received. After the lock closes, the blower continues to operate until the lines are once more clear. If the lines are busy when the panel checks the signal, it will remember it until they are free.

Extrudo-Film uses two systems: the first, a negative-positive type to convey resin from container to storage; and the second, a positive type to convey material from storage to process. When a certain material is needed for process, it is injected into a single conveyor line which serves all six silos by opening an air-operated cutoff gate. It goes first to the weigh bin, and then continues on to the processing area.

Pneumatic conveying is useful not only for resin, but for fillers and other ancillary material. General Electric Co., Pittsfield, Mass., conveys wood flour used as a filler for phenolic molding compounds pneumatically. Because of explosion hazards inherent in the handling of wood flour, Fuller Co. installed two suction systems. The first unloads material from railroad cars into two silos, and the second conveys it more than 360 feet for processing. In the first line, six inches in diameter, a 40-hp. exhauster draws material at the speed of six tons per hour. A 50-hp. exhauster recovers the material from storage at a rate of five tons an hour through a five-inch line.

Controls

The larger the pneumatic conveying installation, the more complex the controls. Most installations are automated to the extent that the controls may require only the part time services of a single operator. As has been indicated in the diverse Western Electric lines, the machinery itself is responsible for delivery signals, starts, and stops. In most systems, once the hoses have been attached and the switches from the master control panel set, there is little work involved.

Economics

Of the several possible sources of savings by pneumatic conveying, there is one by which every processor may benefit—the reduced resin price. There are others, however, which may be equally important. One of these is labor. In some parts of the country, labor union laws will not allow the manager to release handling men for other jobs. In these instances, savings on labor may not be a consideration. On the whole, though, this is an important source of economy.

Since bulk resin may be stored in hopper cars, Sealdbins, or metal silos, indefinite outdoor storage is possible. Not only does this decrease warehouse space required, but since there is no fire hazard as with pallet and cardboard box storage, insurance rates may be lowered. Finally, with pneumatic handling, there is no open dust generation, and housekeeping is eased immeasurably.

Because the resin suppliers pay the basic costs for hopper cars and Sealdbins, there is no expense to the processor unless he keeps them over the allotted time. At times, however, it may be advisable to install storage silos, either indoors or out. If silos are to be used, their number and capacity will naturally depend upon the quantity and variety of resin needed. In general, the recommended minimum capacity is 150,000 pounds.

(*Continued on page 54*)

KENNETH W. CARROLL*

Vary the catalyst to vary epoxies' bonding properties

Various combinations of hardeners with one epoxy adhesive gave a wide range in such properties as hot strength, peel strength, solvent resistance, and pot life. With this in mind, it may not be necessary to purchase a special type adhesive for a given application, but merely check with the adhesive supplier as to which hardener should be used.

—Editor

Epoxy adhesive manufacturers usually recommend one or two catalysts for each general purpose adhesive. One catalyst may cure at room temperature; another may cure more rapidly at higher temperatures. In either case, these catalysts will produce an adhesive system having the best possible balance of properties for a wide variety of applications. In order to obtain this balance, certain properties may be enhanced at the expense of others. To increase peel strength and adhesion to diverse materials, the adhesive is flexibilized. The addition of flexibilizers, however, generally lowers hot strength and both solvent and chemical resistance.

It is apparent, therefore, that the catalysts recommended for general purpose adhesives produce systems having the best compromise of properties rather than the ultimate in any single property. Certain "specific use" adhesives are designed for high temperature resistance, for solvent resistance, or for adhesion to a specific plastic such as nylon. In the scope of this paper, we are concerned not with types such as these, but rather with general purpose epoxy adhesives.

Many consumers of epoxy adhesives are unaware of the variation in specific properties such as hot strength, peel strength, and solvent resistance which are obtainable merely by changing the catalyst. Consultation with the adhesive supplier will reveal that, while Catalyst X may be recommended for use with Adhesive A for the best balance of properties other hardeners may be substituted to reinforce the adhesive in those areas of performance which are of greatest interest in a given application.

A study was made to show the effect of catalyst variation on the bonding properties of an epoxy adhesive. The adhesive chosen was a general purpose, 100% reactive, solvent-free, intermediate strength type —Bondmaster M688#. Because of its thixotropic character, this material adheres to many diverse surfaces, offers ease of handling, and has enjoyed wide commercial acceptance.

Although Bondmaster M688 is generally recommended as a room temperature curing adhesive, hardeners selected for this study ranged from room temperature curing to high temperature curing types. They included diethylaminopropylamine, a moderate temperature curing amine; dimethylaminopropylamine, a a room temperature curing amine; CH-16#, a proprietary hardener best described as a flexibilized amine; Versamid 125**, a polyamide; and CH-60#, a liquid modified aromatic amine.

Properties investigated were tensile shear at room temperature and at 180°F., peel strength, and solvent resistance. Table I shows the mixing ratios in part by weight, cure cycles, and pot lives for the combinations studied. For convenience, the combinations have been designated A, B, C, D, and E.

Combination A—M688 with diethylaminopropylamine

* Mgr., Tech. Service, Rubber & Asbestos Corp., Bloomfield, N. J.

Combination B—M688 with dimethylaminopropylamine
Combination C—M688 with CH-16
Combination D—M688 with Versamid 125
Combination E—M688 with CH-60

Combination F, consisting of a high strength, fluidized epoxy adhesive (Bondmaster M683 with CH-60 catalyst), was included to illustrate the degree of strength retention at elevated temperatures to be expected from an adhesive of this type as opposed to the fall-off in values experienced with flexibilized, general-purpose types exemplified by Bondmaster M688.

Experimental procedure

Tensile panels were prepared in accordance with MIL-A-5090B. Stock used was 0.064-inch 2024 T3 Alclad, vapor degreased in trichlorethylene, followed by a 10-inch etch at 140-160° F., in a solution composed of:

Sulfuric acid (sp. gr. 1.84)	10 pbw
Sodium dichromate	1 pbw
Water, deionized	30 pbw

Glue line thickness averaged 0.0035-0.0045 inch for tensile specimens.

Peel specimens were prepared and tested according to MIL-A-25463. Skins were 0.02-inch 2024 T3 Alclad, vapor degreased in trichloroethylene, then etched as above. Cores were 0.625-inch thick 3-20P (3003) aluminum, ¼-inch cell size. In the preparation of peel specimens, tapes of the adhesives were made using as the carrier—Hess Goldsmith #32 glass cloth with Volan A surface treatment. Adhesive thickness was 0.017-inch.

Castings 1.75 inches in diameter by 0.25-inch thick, cured as indicated in Table I, were used in the accumulation of solvent resistance data.

Pot lives were determined on ½-pound mixes in 8-ounce glass jars at 77° F. In this determination, the criterion was usability of the mixed adhesive as determined by spreading small amounts at varying time intervals.

Test results

Fig. 1 shows the tensile shear strength values at room temperature (77° F.) and 180° F. Combinations A and B, with amine hardeners, provide modest room temperature values with a slight fall-off at 180° F. Combinations C and D, with flexibilized hardeners, show good values at room temperature but, particularly in the case of Combination D, severe reductions in strength at 180° F.

Within the limits of experimental error, the tensile shear of Combination E is virtually unchanged at 180° F. Combination F, designed for service at temperatures up to 260° F., demonstrates good values at room temperature, at 180° F, and at the higher value. High room-temperature strengths of C, D, and F can be attributed, at least in part, to more complete wetting of the metal. This is due to the high hardener/resin ratios in the cases of C and D, and to a low initial viscosity in the case of F.

At higher hardener concentrations, the mixed viscosities of C and D are lower—even though non-sag properties are unaffected. Combinations A, B, and E contain smaller amounts of hardener, and have higher initial viscosities. There is, consequently, reduced wetting of the metal.

Another important factor in obtaining high room-temperature strengths is that flexibilized systems such as C and D yield slightly as the metal elongates under stress. Rigid systems such as A, B, and E do not possess this slight degree of elasticity and consequently fracture under lower stresses.

Table 2 combines peel strength tested as per MIL-A-25463 with solvent resistance as indicated by Shore A hardness after 7-day immersion in ethanol/toluol, methyl ethyl ketone, and toluol. No peel values were determined for F, since this low-viscosity fluid adhesive is not suitable for honeycomb bonding.

Predictably, C and D, with flexible hardeners, give the best peel values. Combination A, with a "rigid" hardener, posted a peel value of 6.7 inch pounds per inch. Of the formulations tested, D alone exceeds the requirements of MIL-A-25463 (8.5 in. lbs/in. or 25.5 in. lbs/3 in. width). Peel values in all cases may be improved by priming the skins with an elastomeric adhesive (such as Bondmaster M602#).

Combinations A, B, E, and F are unaffected by the test solvents, whereas C and D are softened slighlty. It must be pointed out, however, that the solvent resistance of C and D is far superior to that of the most elastomeric adhesives.

Conclusions

From these results, it can be seen that a broad spec-

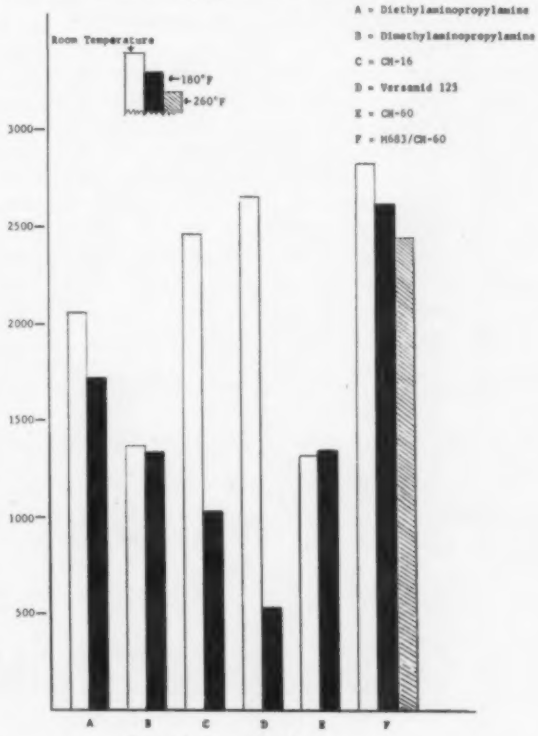


Figure 1. Shear Strength, psi

Product of Rubber & Asbestos Corp.
** Product of General Mills Chemical Division, Kankakee, Ill.

trum of properties is obtainable from a single adhesive simply by changing hardeners. Combination A would be chosen as a moderate temperature curing adhesive for intermediate strength applications requiring long pot life and good solvent resistance—with minimum fall-off in strength over a fairly wide temperature range. Combination B is an intermediate strength, room temperature curing adhesive with fairly long pot life and good solvent resistance. Its strength values are also fairly constant over a range of temperatures.

Combinations C and D combine good tensile and peel properties for applications where service temperatures are not severe and where solvent resistance is not of prime importance. Combination E is recommended where strength requirements are not high, but where solvent resistance and strength retention at 180° F. are considerations. Combination F, of course, is specified for high strength, high temperature applications. Close liaison between adhesive customer and supplier is necessary to determine the best resin-hardener system for a specific application.

Table I

Combination	A	B	C	D	E	F
Bondmaster M688	100	100	100	100	100	—
Bondmaster M683	—	—	—	—	—	100
Diethylaminopropylamine	6	—	—	—	—	—
Dimethylaminopropylamine	—	6	—	—	—	—
CH-16	—	—	32	—	—	—
Versamid 125	—	—	—	32	—	—
CH-60	—	—	—	—	13	20
Pot life, hrs.	1.5	1.5	0.75	3	3	3
Cure cycle, ° F., hrs. or days	200, 1.5 hrs	77, 7 days	77, 7 days	77, 7 days	330, 2.5 hrs	330, 2.5 hrs

Table II

	A	B	C	D	E	F
Peel strength, in. lbs/3 in. width	20.1	15.2	25.4	28.3	11.7	—
Hardness, Shore A after 7 days immersion in:						
Ethanol/toluol	100	100	75	70	100	100
Methyl ethyl ketone	100	100	85	80	100	100
Toluol	100	100	90	85	100	100

Pneumatic materials handling—a survey report
(*Cont'd. from page 51*)

Silos may be constructed of aluminum or epoxy-lined steel. Since welded aluminum has no irregularities or joints, there is no tendency for material to leak or collect. However, welded aluminum is far more expensive than steel. Whatever the silo material may be, a vibrator should be employed to shake fines off the walls. This prevents cross contamination when two or more resins are stored successively in the same silo.

Of course, since most systems are custom designed, it is impossible to present an over-all cost estimate. Once a pneumatic conveying system is installed, economy of operation depends largely upon the horsepower needed to convey a ton of material, and ease of maintenance. The smaller these factors, the greater the economy. Thanks to the savings accruing from its conveyor system, Extrudo-Film was able to pay off its initial investment in three months.

—The End

Don't miss next month's
Special Issue
on
INJECTION MOLDING

Consultant's column

Edited by: DR. S. S. STIVALA*

Question: What plastic can be used for die-casting?

Answer: Polyformaldehyde resin is reported to be suitable.

Question: I understand that plastics have been used as injection molds. If this is so, what plastic is used?

Answer: Plastics tooling and molds consist of fiberglass bound with such resins as unsaturated polyesters, phenolics, epoxies, or combinations of these. Such tooling industries as the aircraft and automotive have found that steel or aluminum items can be produced at considerable savings in cost and time with plastic tooling.

Question: Can you give a brief account of the future of epoxy terrazzo?

Answer: Conventional concrete terrazzo has enjoyed wide acceptance as an attractive and functional flooring medium for many years. In the north it is generally found indoors—in department stores, supermarkets, and building lobbies. In the south, especially Florida, concrete terrazzo is a common outdoor flooring.

Concrete terrazzo is installed by pouring several inches of concrete over a 1-2 inch underlayment (limiting application generally to ground levels). After 7-14 days, it is hard enough to withstand grinding. It may crack, especially in extereme weather, in which case large sections must be ripped out for repair. By contrast, epoxy terrazzo, in which epoxy resin replaces concrete, offers numerous advantages: it is practical for installation on upper floors because of its light weight (¼-inch thickness); requires no underlayment; can be applied over old terrazzo, wood, or concrete; can be ground and polished within 24-48 hours; and is relatively non-brittle.

The problem in epoxy terrazzo is mainly one of education of and acceptance by terrazzo contractors, who feel that no material can replace concrete. Further there is a dermatitis problem among some sensitive individuals which must minimized with proper handling of materials. Terrazzo contractors shy away from such careful handling even though the advantages of epoxy outweigh the disadvantages. Nevertheless, epoxy terrazzo is slowly achieving a place in the flooring industry and in time, more than half of all terrazzo floors will be epoxy.

Question: How does fluidized bed coating compare with spray coating?

Answer: Fluidizing in the plastics industry is the process whereby a rising stream of air suspends finely-divided resin powder, thus imparting fluid-like characteristics to the powder.

Objects to be coated are preheated, immersed in a tank containing fluidized resin, and postheated from 5 to 15 minutes, depending on their size and the type of resin—PVC, epoxy, etc. Fluidized bed coatings combine a solventless system with thick coatings (0.005-0.050 inch) in one dip application. However, since fluidization must be accomplished in a tank, coating is limited to objects which fit in the tank. Since the objects must be heated, this limits the application mainly to metals.

Fluidized bed coatings will complement rather than replace conventional spray coatings. Aside from cost, spraying offers other advantages, e.g., the coating of large and non-movable parts.

—THE END

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ENGINEERING FORUM

Compression & transfer molding

Diversify to expand—here are your thermosets

Edited by: PAUL E. FINA*

In preceding articles, this column has covered the following subject areas: Epoxy Molding Compounds (May, 1959); What Should A Thermoset Plastics Engineer Know? (July, 1959); Reinforced Phenolics (Sept., 1959); Automate To Stay Alive (Jan., 1960); When Quality Is More Important Than Price (July, 1960); How Close Your Tolerances (Oct., 1960); and a host of other subjects.

These particular articles may have impressed the thermoset molder with the ramifications of our growing industry. Throughout the country, molders in certain areas are "provincializing" or specializing in some particular phase of thermoset molding; the basis for choice being the demands of industry, the local market, or the trend as established by other local molders.

This latter point is the purpose behind this article —most local molders continue a trend, thus exhausting the number of applications available. Ultimately, this entrenchment in a particular plastics field precludes all diversification. In other words, the molder is in a rut!

Generally, the Northeastern section of the country stays with the electrical and electronic industry. The Midwest seems devoted to the conversion into plastics of applications which are currently in metal, wood, etc. The West seems to concentrate on structural applications. It must be noted that this particular breakdown refers primarily to the custom molder, the backbone of the thermoset field—as yet. In each area, there are captive molders, proprietary molders, specialists in certain types of molding materials, etc.

To show the present diversification within the thermoset industry, let's review the techniques employed to fabricate thermosetting materials: general purpose and improved-impact molding, reinforced (impacts) molding, premix molding, pre-preg (laminate), filament winding, preform mat, spray-up, hand layup, and autoclave bag or hydroclave bag molding. Many molders have developed skills in most of these categories.

At this point, it should be indicated that there is a difference between reinforced molding compounds and premixes. The Society of the Plastics Industry has arbitrarily classified reinforced molding compounds along with premixes. However, there is need for clarification as to when a material is a compound and when it is a premix (See Premix Molding).

The purpose of this article is to outline the thermoset field in its broadest sense. There may be molders or fabricators in the thermosetting field who are interested in the range of products that can be made with the various materials and molding methods. They may be induced to branch out into these categories, if they are feasible. Each area of the country should have applications that can be developed in all types of thermosets.

Brief survey of the thermoset field

Basically, the plastics used in the thermoset field are phenolics, melamines, ureas, epoxies, silicones, alkyds, diallyl phthalates, and various types of polyester premixes (the polyester family of materials often includes the alkyds and diallyl phthalates). The reinforcing fillers generally used are synthetic fibers, glass fibers, glass mats, fabrics of all types, yarn or rovings, asbestos cords or fibers, and sisal. With conventional molding compounds, the standard (non-reinforcing) fillers are wood flour, cotton or wood flock, minerals, paper, etc. Both types, however, do affect mechanical strength, dimensional stability, wear resistance, electrical properties, etc. Some of the molding and fabricating methods as used in industry are described below:

GENERAL PURPOSE AND IMPROVED IMPACT. These materials are molded by compression or trans-

* Director of sales engineering, Fiberite Corp.

fer molding techniques. They are used when impact requirements are low.

REINFORCED PHENOLICS (IMPACTS) MOLDING COMPOUNDS. These materials are molded by compression or transfer molding techniques, but with slightly higher molding pressures. There are types available for mechanical, structural, electrical, and chemical applications.

PRE-PREG (PRE-IMPREGNATED) MATERIALS. These materials are similar to the laminate cloth types. To some molders, a molded pre-preg is a molded laminate. Pre-pregs can be compression molded, transfer molded, vacuum bag molded, or used in lay-up techniques. They are cut or chopped to size for transfer molding. Pre-preg molders have found a huge market in the structural field and in the rocket and missile fields. Pre-pregs of all resin types are manufactured to close tolerances or critical applications. Most widely used reinforcing materials are glass fabric, silica fabric, cotton cloth, paper, woven asbestos, graphite papers, and synthetic cloth.

FILAMENT WINDINGS. Coated rovings are wound concentrically about a metal form in various cross patterns. The highest strength possible of any plastics is available through filament windings. Pressure bottles, radomes, motor cases, pepes, etc. are excellent applications for the filament winding techniques.

PREFORM MAT MOLDING. A preform mat is made by the felt process so that it conforms to the intended product. Matched metal die molds are used for fabricating or molding. The felt or mat preform is located in the mold. Resin is usually poured or saturated throughout the mat just prior to molding. Boats, large housings, etc. are typical applications.

SPRAY-UP FABRICATION. Hand lay-up molds are used (See Hand Lay-Up Fabrication), but the reinforcing material and resin are applied directly to the mold with spray guns. The guns deposit the mix of resin and fiber directly onto the mold or form. Such applications as boats, swimming pools, tanks, etc. are typical of these spray-up techniques.

HAND LAY-UP FABRICATION. A woven fabric or felted mat is laid up by hand over forms or molds of wood, plaster, etc. The layers of reinforcement are coated with resin and a gradual build up of reinforcement and resin is effected. To cure, the lay-up is allowed to air-harden or is baked in an oven. Panels, ductwork, housings, etc. are typical applications.

AUTOCLAVE BAG OR HYDROCLAVE BAG MOLDING. This method is used extensively when very large parts must be molded. Usually, the female part of a mold is fabricated and the pressure is supplied by the use of a rubber bag inflated to form the male part. With the autoclave method, the final curing operation takes place in an oven under bag pressure. In the hydroclave technique, the bag is inflated with hot oil and heat curing is accomplished directly under pressure. These two methods of molding are extremely important when the size of the part goes beyond the limits of available press capacity.

PREMIX MOLDING. Premixes are usually made with polyester resins; however, phenolics are sometimes used. The word premix implies that components are mixed mechanically. They differ from molding compounds in that little segregation control and no impregnation is attempted in the mixing operation. These materials are economical to make. Reinforcing fillers include glass, sisal, asbestos, and synthetic chopped fibers. The premixes are molded similarly to straight molding compounds. They are used for trays, handles, boxes, housings, ducts, electrical appliances, etc., and are usually available in a doughy mass or extruded "rope" rather than in bulk or preform as are molding compounds. Flow or plasticity and volatile content are not usually measured.

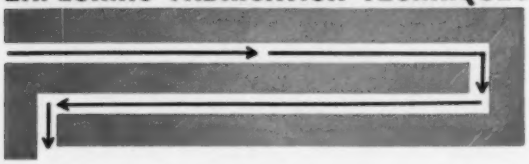
I hope that the above descriptions and accompanying property charts may encourage some thermoset molders to investigate the possibilities of diversification. There are countless applications still waiting for a good sales engineer to find them. Through intelligent use of fabrication or molding techniques, the plastic industry (especially the thermoset) can expand many times more. It is well to study the available properties afforded by each type of fabrication before deciding upon the material. It may be better for a molder or fabricator to consider diversification rather than attempt to convert all applications to his own specialized field. If you want to expand, diversify!

Composite data on reinforced phenolic molding compounds

Specific Gravity	1.25-2.0
Tensile Strength, psi.	5,000-18,000
Compressive Strength, psi.	17,000-35,000
Flexural Strength, psi.	10,000-30,000
Flexural Modulus, psi.	0.5×10^6-3.0×10^6
Impact Strength, ft. lbs./in.	1.0-20.0
Hardness (Barcol)	50-90
Moisture Pick-up, %, 24 hrs. @ 23° C.	0.10-2.0
Burning Rate	Slow to None
Heat Resistance (Continuous), ° F.	250-450
Resistance to Acids and Alkalis	Poor to Excellent
Resistance to Solvents	Excellent
Machining Qualities	Poor to Excellent
Dielectric Constant, 1 Meg.	4.0-8.0
Dielectric Strength, V/Mil	90-450
Arc Resistance, Seconds	5-180
Power Factor, 1 Meg.	0.015-0.10
Molding Shrinkage, in./in.	0.0001 to 0.008
Volume Resistivity, ohm.-con.	10^9-10^{14}
Resin Content, %	25-60

—THE END

PLASTICS TECHNOLOGY
EXPLORING FABRICATION TECHNIQUES



By L. J. ZUKOR, *ENGINEERING EDITOR*

Polysulfide Casting Techniques

Vacuum formers owe many of their techniques to the map making industry. Under duress from the Military during WW II, cartographers developed many of the basic vacuum forming practices for manufacturing their topographical relief maps. In the intervening years, other improvements in plastics processing have also been initiated by these map makers.

One manufacturer of relief maps, Aero Service Corp., Philadelphia, Pa., had to cast a 9 x 36 ft. secondary mold. Polysulfide material was chosen because its physical properties were eminently suited to the project's requirements. Elastomeric flexibility was needed to facilitate rolling the large map for storage and transportation, and its dimensional stability (less than 0.2% shrinkage) provided extreme accuracy in reproduction.

With all their good qualities, polysulfide resins still have one drawback—a relatively short pot-life. All known formulations (see elastomeric polymer, our Nov. '59 issue, page 53) have approximately a two hour maximum pot life after mixing. Like polyesters, polysulfides are thermosetting; therefore, they must be used with a catalyst or curing agent. The type and amount of catalyst strongly affects the pot (working) life and the molding characteristics of the resin.

As Dr. Walther L. Barth* explained: the huge casting weighed 2,200 lbs. and had to be poured in one shot to prevent weak spots and stratification. Too fast a gel time with material which has a pot life of two or three hours would produce this unwanted effect.

Extending pot life also extends cure time which, at best, would make it difficult to achieve full cure. Curing would extend for periods of several weeks or longer, thus negating the benefits of a longer working life.

Glass mat reinforcement improved the tear strength

Typical Formula for "Thiokol" Casting Compound 4 hr. working life—Twin Mix

I.		
1.	Disulfide Poly Rubber (Thiokol LP-32)	100 lbs.
2.	Zinc sulfide	46.7 lbs.
II.		
3.	Dibutylphthalate	26.5 lbs.
4.	Iodine	0.03 lbs.
5.	Cumene Hydroperoxide	8.25 lbs.
6.	Dow-Corning anti-foam	0.22 lbs.

Item 1. Rubber Base
Item 2. Filler
Item 3. Plasticizer
Item 4. Activator (proportioning) (0.5% solution in dibutylphthalate)
Item 5. Activator
Item 6. Anti-Foam Agent (50% solution in benzol)

* Senior Physicist for Aero Service Corp.

Photo courtesy: Aero Service Corp.

Batch mixing resin ingredients prior to casting.

Photo courtesy: Aero Service Corp.

Pouring resin mixture onto glass mat reinforcement.

of the polysulfide elastomer and facilitate removal of this heavy casting from the master mold. The mat was laid onto the first resin pour after it had gelled sufficiently to support the load. Dr. Barth also had devised a catalyst system** which would control and extend the working life of the combined ingredients without affecting cure time. This catalyst system uses a small amount of iodine (which is regenerated by the presence of a peroxide) to oxidize the reactive group of the unsaturated liquid resin. Thus permitting a flexible pot-life/cure-time ratio.

The iodine reaction can take place in the presence of either an alkali or an acid; i.e., diphenylguanidine or oleic acid, either of which speeds the reaction. Pot life varies over a range from a few seconds duration to more than ten hours, depending on which is used and in what concentration. Unlike solid lead peroxide particles, which have to be mixed thoroughly with the resin, iodine diffuses readily through the prepolymerized mixture.

The use of iodine as a catalyst gives reproducible results even under varying atmospheric conditions. When iodine crystals are used, they are first dissolved in dibutyl phthalate. Good results have also been achieved with halide salts and organic iodine donors. The reaction will take place with most organic compounds in which iodine is loosely bound in the molecule.

Similar progress has also been made in the reinforced plastics field. Here, polyester and epoxy formulations have been developed which extend the working life of the resins. Some formulations can even be gelled and cured at will. The Brooklyn Navy Yard laboratories has recently completed its program on the ultra-violet ray curing of unsaturated polyester resin systems. (See J. Kaminetsky's article—this issue.)

** U.S. patent No. 2,727,883

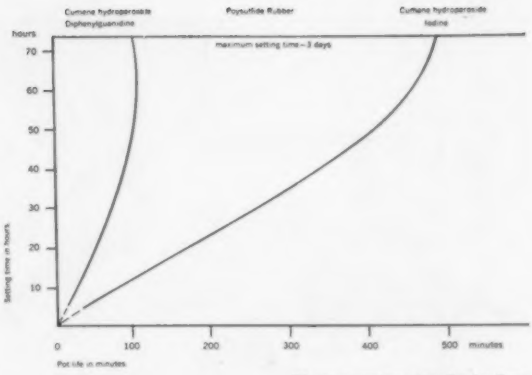


Diagram courtesy: Aero Service Corp.

Graphic comparison of standard cure versus iodine cure.

Extruded film, thickness gaging

The failure of many extruders to adhere to tolerance standards has created problems for everyone concerned in the production of printed overwrapping and bags. The extruder buys his resin by weight. He also sells by weight to the converter who, in turn, has specified his purchase by film thickness and roll width. The converter would prefer to buy rolls by length rather than weight, since this is the way he must determine his price to the end user.

Film gages must be held consistently, otherwise the extruder is, in a sense, cheating either the converter or himself! Many small and/or shortsighted extruder and converter firms have gone out of business for just this reason. The converter must know approximately how many feet he is actually getting, since the

Photo courtesy: Saturday Evening Post, Larry Keighley, photographer.

The 9x36 foot plaster relief map. A polysulfide secondary mold is made from the master pattern. Reproductions made of the same resin provide the maps used in radar trainers.

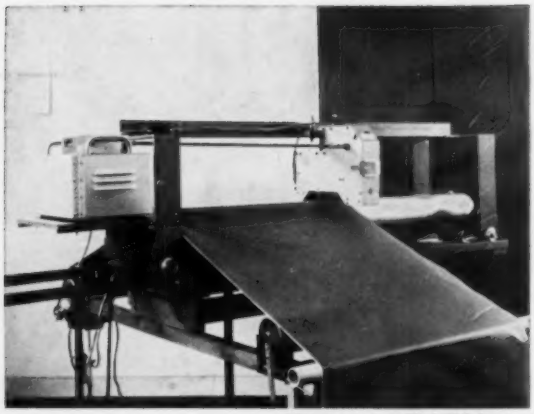
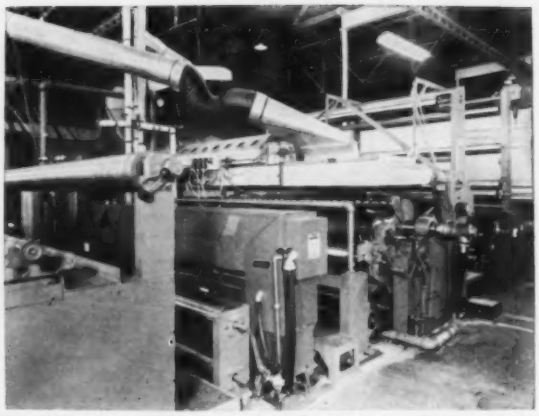


Diagram courtesy: Mark-N Laboratory

Optical thickness gage mounted on traversing mechanism.



Tracerlab Beta Gauges continuously measure plastic coating thickness on paper at American Sisalkraft Corporation. Laminating is at 1,000 feet per minute.

profit margin is very narrow all along the line. If the film runs thicker than specified, the converter is getting the proper poundage but much less film than anticipated. Too thin films offer more footage, but may be unacceptable to the end user. In either case, the converter loses his customer.

The extruder, too, is in trouble if he does not hold tolerances. To avoid losing his converter customer, he may "make up" the extra footage to the expected amount. At this rate, how long can he stay in business?

The large film manufacturers have set their own standards for film gage and tolerances. These standards, sponsored by SPI, have been published by the Department of Commerce. Many of these standards are quite "loose," and any film extruder having undue difficulty conforming to them should seriously consider the advisability of remaining in this field. For example, yield tolerances for polyethylene film are ±10% for any one roll or for lots up to 500 pounds. In the latter case, this means that in five 100 pound rolls at least two can be as much as 20% thicker and be short in length while the balance of the rolls can go to the other extreme. The specification CS227-59 for polyethylene film establishes quality criteria for 1-4 mil thick film having a density of 0.914 to 0.929 g/cm³. Specifications also exist for vinyl and other film grade resins.

CS227-59 concerns extruded film only and makes no distinction between blown film and chill roll cast film, even though thickness tolerances are more difficult to maintain in the manufacture of blown film. What, then, should the standards in film gage tolerances be and how can these be held?

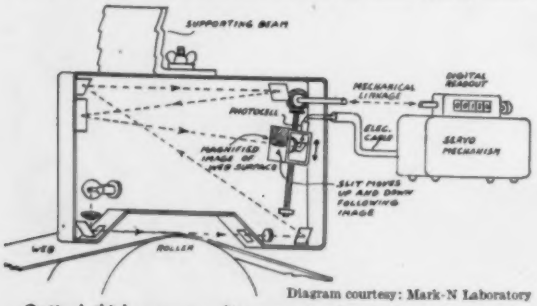


Diagram courtesy: Mark-N Laboratory

Optical thickness gage diagram—showing light path to photo cell mounted in movable carriage.

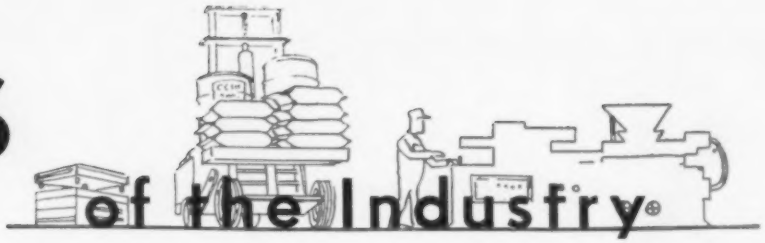
Most large film extruders are able to hold gage tolerances closer than those established by specification. They do this by installing gage controls, thus ensuring tighter thickness tolerances for their customers. Smaller extruders would be in a better position to compete, if they were also to invest in similar equipment.

Film extruders have available a choice of several good indicating and recording devices. Speed of response and accuracy of indication (at least to the fourth decimal place) is required. These characteristics need be only as fine as necessary for the particular extrusion operation. Hypothetically, a response of 0.2 sec at a web velocity of 1,200 ft./min. would allow 4.0 feet of material to pass by before the indicator would show a reading, while at 300 ft./min. this same instrument would indicate a change occurring in each foot of material passing. In the first instance the instrument might not be fine enough; and in the second, it could be too fine.

Three general types of thickness gages are presently being marketed, these are: nuclear and electronic; fully mechanical; and electro-mechanical units. I have recently seen an optical unit in operation (which falls in the last category). This unit, unlike the fully mechanical unit, does not contact the web and is similar to the nuclear-electronic unit in this respect. Paul Selgin, the designer of this optical follower type thickness gage, pointed out some of the features of his instrument to me. The instrument mounts over either an idler or driven roll on the take-off equipment. It can also be supplied with a special idler roll carriage which allows the gaging head to traverse the web at a predetermined rate while the film passes over the roll. The instrument gages a change in thickness by taking a zero reference from the roller O.D. Measurement read-out occurs when the beam of light is interrupted by the film thickness. The "on-off" signal from the photo cell is balanced by a reference voltage in the servo circuit. When an imbalance occurs in the bridging circuit, the servo motor drives the photo cell carriage either up or down (according to the gage condition) until a balance is reached.

—THE END

NEWS of the Industry



changes in ownership, new companies

Lock Joint Pipe Co., East Orange, N. J., has acquired Corroplast, Inc., Passaic, N. J., extruder of rigid PVC pipe and sheet. The parent firm manufactures pressure, sewer, and culvert pipe.

Flo-Tronics, Inc., Minneapolis, has acquired the assets of Kenco Plastics, Walker, Minn. The latter will be integrated with another Flo-Tronics subsidiary, Wilcox Products Co., a custom molding operation.

Vector Plastics Corp. has acquired Fairchild Plastics, Copiague, N. Y., a former branch of Fairchild Engine & Aircraft Corp.

Great Bay Chemicals & Plastics, Inc., has absorbed Regency Plastics, Inc. Both firms are Cary Chemicals subsidiaries; the former calenders vinyl sheeting, and the latter performs finishing operations on vinyl and extrudes polyethylene.

J. E. Stearns & Co., Inc., has purchased the Pre-Preg Division of Sonic Aviation. Stearns was formed to bring together the activities of Fiber Glass Service, Inc., with the Pre-Preg Division. Its location is 1741 Potrero Ave., S. El Monte, Calif. Vanderbilt Industries will represent J. E. Stearns & Co. on a nationwide basis.

Kleen-Stik Products, Inc., has become a wholly owned subsidiary of National Starch & Chemical Corp.

Borden Co. is negotiating to acquire the assets of Columbus Coated Fabrics Co., Columbus, O. On completion, Columbus would operate as a separate division of Borden Chemical Co., under its present management, name, and organization.

news from abroad

Czechoslovakia. Plastic material production reached 53,000 tons in 1959, a 500% increase over 1950. Practically no polyethylene was produced; however, plants are being built and 1965 figures are expected to reach 150,000 tons. A new process is claimed possible of producing blocks of nylon large enough for big machinery components and structural elements like keels for ships.

F. J. Stokes Corp. has established a subsidiary company in Great Britain—F. J. Stokes, Ltd., with headquarters in London.

Japan. Polypropylene is being produced experimentally by Tokuyama Soda Co., by its own process involving electrical discharge polymerization—without the use of an expensive metal alkyl catalyst. The company has registered five patents for the process.

new plants, labs & additions

Combined Electronics, Inc., has leased an office-factory building at 4616 W. 20th St., Cicero, Ill., for expansion of its production of molded plastic wiring panels, plated circuitry, and automatic machinery.

General Electric Co. is building a Lexan polycarbonate product and process development laboratory in Mt. Vernon, Ind.

Glaskyd, Inc., has moved into a new 13,000 square foot plant and office headquarters in Perrysburg, O.

Nopco Chemical Co. is constructing a $7-million isocyanate plant in the Tremley Point section of Linden, N.J. The completion date will be late this fall, and will make Nopco the only urethane foam producer making its own toluene diisocyanate.

Thermech Engineering Corp. added 5,000 square feet of production space to its plant in Anaheim, Calif., earlier this year. The firm processes fluorocarbons—molding, machining, and coating.

Excelsior Plastics, Inc., a wholly owned subsidiary of Northwest Plastics, Inc., has opened a 15,000 square foot plant in Belle Plaine, Minn. The $350,000 plant will employ over 100 people on three shifts.

Filon Plastics Corp. has opened a Midwestern division headquarters in Skokie, Ill. The 12,000 square-foot warehouse and sales office will speed delivery of reinforced plastic building panels in the area.

United States Testing Co. has opened a sales office at 9 West Washington St., Chicago, Ill.

business developments

Molded Fiber Glass Companies have completed a program to double capacity of their polyester resin plant in Ashtabula, O. Annual volume is now 10-million pounds.

Nopco Chemical Co. has doubled its capacity for producing thin-sheet polyester foam at its North Arlington, N.J., plant.

Falcon Chemical Corp., Lake Charles, La., is using Byers PVC pipe for a mixing header where 98% sulfuric acid is mixed with water to obtain a 5% H_2SO_4 solution.

Names in the News

Dr. W. J. Belanger

W. J. Belanger has been promoted to the position of director of resin development in Jones-Dabney Co., a division of Devoe & Raynolds Co. Dr. Belanger is replaced in the position he had held since 1957, manager of the plastics technical service laboratory for Jones-Dabney, by **W. F. McWhorter.** The latter has been group leader in the epoxy resin development laboratory since 1956.

Norman A. Klemp has been named vice president of Pacific Moulded Products Co. He joined the company last year as plant manager, a position in which he will continue, after serving as assistant to the president of Sheller Mfg. Corp.

Dale E. Jackson is the new manager of the plastics department for Butler Industries Division, Butler Mfg. Co. Dr. Jackson, who has been with Butler since 1957 as senior research chemist, previously worked with textile fibers research at Du Pont.

John P. Kiczek

As production manager, plastics division of Nopco Chemical Co., **John P. Kiczek** will handle foam slab production, foam slitting and packaging, and resin production and packaging. With Nopco since 1948, he was formerly production manager for resins and systems packaging.

K. Henry Stroh has been appointed field engineer by John Royle & Sons, with whom he has been associated for 17 years.

Two divisions of Allied Chemical Corp. have announced managerial appointments. **Neal M. Draper** has been appointed vice president of the National Aniline division. He will be responsible for sales of organic chemicals and dyestuffs and pigments. At the general chemical division research laboratory, **Otto G. Direnga** has been named director of research administration. **Walter G. King, Jr.,** succeeds Mr. Direnga as director of planning research. He, in turn, is succeeded as assistant director, by **Charles D. Boyer, Jr.,** formerly manager of engineering research. Mr. Direnga will supervise overall administrative activities of the laboratory, while the last two will evaluate research projects and programs.

Executive appointments in the plastics division of Allied Chemical Corp. include **Roy L. Ammann,** senior vice president; **Bennett D. Buckles,** vice president—sales; **James M. Maddox,** vice president—operation; and **Damon A. Peterson,** vice president—technical.

William H. Otto

William H. Otto is now research specialist in the research and development division of Narmco Industries, Inc. He will be engaged in research programs on aircraft, missile, and marine design and engineering.

Edgar E. Wrege has been designated administrative assistant to president **Herschel H. Cudd** of AviSun Corp. Since 1959, Dr. Wrege has been operations manager of the special products department, Avisco Film division, American Viscose Corp.

Four men have been promoted to high positions by U.S. Rubber Co. **Earle S. Ebers,** vice president and general manager of Naugatuck Chemical division, has been named group vice president in charge of polymer, fiber, and chemical operations. He is succeeded as general manager of Naugatuck by **Dudley Chittenden,** who was also elected a vice president. At U.S. Rubber's research center in Wayne, N. J., **Dr. Clide I. Carr** and **Harry S. Witt** were appointed manager of the synthetic fiber research department and manager of the plastics research department, respectively.

Edward J. Henlin has been appointed superintendent of the plastic division of Lockard Tool & Engineering Co. He formerly was production manager at Zenith Plastics.

Hubert M. Aronson

Hubert M. Aronson has joined Reichhold Chemicals, Inc.'s Alsynite division as vice president. For the past six years he has been general manager of the eastern and southeastern divisions, Filon Plastics Corp.

Robert D. Beattie is holding the newly created position of polyolefins manager, new products research department, Cabot Corp. Dr. Beattie joined Cabot in 1951 as project engineer, and later advanced to senior chemical engineer, a position he held until his recent promotion.

J. Howard Brown, Robert F. Schultz, and **Alvin F. Shepard** have been named to new posts in a realignment of the corporate research and development department of Hooker Chemical Corp. **Chris A. Stiegman,** newly elected vice president — research and development, has announced the appointments of Dr. Brown as manager —research, Mr. Schultz as manager—process development, and Dr. Shepard as senior scientist. All report to Dr. Stiegman. They had been respectively manager—chemical research, production manager — eastern chemical division, and manager — plastics research.

Also reporting to Dr. Stiegman are **James Sconce,** technical assistant; **Donald L. Taylor,** manager—general development; **Carl I. Gochenour,** manager—new product development; and **Peter F. Casella,** manager—patents. **Walter S. Beanblossom** is now administrative assistant to Dr. Brown, and those research section managers formerly responsible to Dr. Shepard now report to Dr. Brown.

Edwin M. Lindsay

Edwin M. Lindsay, formerly facilities manager for the Cornell Aeronautical Laboratory, has been designated assistant to the director of research of Owens-Corning Fiberglas Corp. He was with the Cornell Laboratory for 15 years.

William J. B. Johnson, production vice president of Valley-National Corp., has been elected president of the plastics company. With Mr. Johnson as production head, the company has developed applications for blister packaging as well as other plastic-paperboard combinations for packaging use.

John I. Rudge has moved up from executive vice president to president of Carlon Products Corp. He has been with the company since 1948. At the same time, **William W. Clark** from Continental Oil Co. was appointed secretary of Carlon.

Plastocon Corp. has announced the election of **Dr. Jay E. Meilli** as vice president and treasurer. **Jerome T. Donahue** continues as president.

J. C. Stansel is now plant manager of Continental-Diamond Fibre Corp.'s Newark, Del., plant. He joined the company in 1958 as manager of process engineering, and his most recent position was manager of manufacturing engineering.

William M. Reed

At a recent meeting, **William M. Reed** was elected president of Plastic Compounding Corp. He joined the firm in 1958 as a vice president and stockholder. Also elected at the meeting were vice presidents **Saul Bolton** and **Louis Colen,** and secretary-treasurer **Ralph Trustman.**

Roy Berg, senior project engineer, has been named chief production engineer by Lunn Laminates, Inc. Production of components for submarines and other marine applications have been under his jurisdiction.

Donald R. Presley has been named plant superintendent for Plastomer Corp., manufacturers of urethane foam for industry. In this newly created position, he will be in charge of plant operation and equipment.

Richard T. Dale has been appointed works manager of Resistoflex Corp. Mr. Dale, who joined the company 11 years ago, moves from assistant to the executive vice president.

Raymond Mich has been named plant manager of Sterling Extruders.

John M. Taylor, Jr.

Edward H. DaCosta

The board of directors of Taylor Fibre Co. has elected **Edward H. DaCosta** president and **John M. Taylor, Jr.,** chairman. Most recently vice president—marketing, Mr. DaCosta joined the company as a sales correspondent in 1938, and has held several sales and managerial positions. Mr. Taylor, who was president and treasurer, has held posts in several of the company's divisions. He was president for four years.

Lester F. Beers has joined Tri-Point Plastics, Inc., as project engineer. Mr. Beers, who has developed successful techniques for processing skived plastic tape, was formerly president of his own firm, Industrial Plastics Engineering Co., Inc.

James V. Williams, a packaging and marketing consultant on foods, has been appointed sales manager of J-E Plastics Mfg. Corp.'s food container division. The company went into production of oriented styrene packaging containers for fresh and frozen foods last year.

Charles H. Frantz has been designated vice president, engineering, by Lenox Plastics, Inc. With Lenox since March, 1960, he will assume responsibility for product and methods development, as well as all manufacturing processes and equipment.

Paul J. LaMarche has been named vice president—production at U. S. Industrial Chemicals Co. With the organization since 1949, he most recently was director of production.

James B. Gergen

James B. Gergen, former technical manager at Minnesota Mining & Mfg. Co., is the new president of Space Structures, Inc. Mr. Gergen, who is also general manager, will concentrate on developing new thermoplastic items and improving production of the company's present products. Space Structures has also announced the appointments of **John D. Anderson** as production manager, and **Robert L. McConnon** as sales manager.

Plastics Manufacturing Co. has announced several executive promotions. **Elgin B. Robertson,** former president and chairman of the board, is now chairman. New president is **W. L. Cone, Sr.,** vice president and general manager. Plant superintendent **James E. Joy** has been promoted to vice president—manufacturing, and housewares division manager **Richard Cone** has moved to vice president—sales. Retiring director and commercial division manager **Norwood W. Beach** is succeeded on the board by **Ralph Belknap,** who is in charge of purchasing and production scheduling. **W. Lloyd Cone, Jr.,** assumes the post of chief engineer and is also in charge of research and development. **Gilbert Robertson** was appointed in charge of production operations.

Stuart L. Brown, Jr.

Stuart L. Brown, Jr., has been promoted director of plastics research in the packaging research division of Reynolds Metals Co. Previously staff assistant in the plastics department, he will now be responsible for all research activities pertaining to Reynolon films.

John W. Hawley is now chief product engineer — thermoplastics of the molded products division, Stauffer Chemical Co. As such, he is responsible for coordinating new product development and providing technical assistance to sales and engineering assistance to the thermoplastics fabrication departments.

Appointment of **Norman F. Singer** as general manager of American Aerophysics Corp., wholly owned subsidiary of Harvill Corp., was announced by the parent company. An industrial engineer, Mr. Singer has been with American Aerophysics since 1959.

J. B. Schmitt has been appointed manager of production for Durethene film operations of the plastics division of Koppers Co., Inc. He moves up from product manager for Dylene polystyrene in the division's marketing department.

OBITUARY

Alfred F. Bahlke, a partner in Berkeley Engineering and Mfg. Co., Berkeley Heights, N. J., died on Feb. 28 after a long illness. Born in Kiel, Germany, Mr. Bahlke had resided in the United States for 22 years.

He was a member of SPE and on the board of directors of the Summit Federal Savings and Loan Association, Berkeley Heights branch.

New Materials

For more information check Readers' Service Card (p. 83)

Urethane molding resin

A resin which permits mass production of urethane elastomer items by injection and transfer molding or extrusion has been announced by Mobay Chemical Co. The resin, named Texin, is supplied in granular form to molders and extruders, and reportedly cuts forming time for cured urethane elastomer parts from hours to seconds. It can be molded with standard molds and equipment, attaining properties comparable to those of cast urethane elastomers.

Major properties of Texin are toughness; resistance to abrasion, oils, and solvents; and combination of hardness with elasticity. It is supplied in different grades of hardness. A material with durometer hardness of Shore A 60-65 can be elongated 500-800%, while up to 250% elongation is possible at 65 Shore D hardness.

The material is expected to find application in mass produced parts such as those used by the automotive and original equipment industries. It can be extruded for hoses, tubing, profiled channeling, and cable jacketing. Mobay is also developing consumer applications, such as molded lifts for women's shoes. However, the company has indicated that liquid casting of urethane elastomers will continue for large size items such as industrial truck tires or parts which would require heavy outlay in mold design costs.

Readers' Service Item 1

Acrylic-based emulsion

An acrylic-based emulsion which can be used to formulate clear, colored, pigmented, and grease resistant coatings for paper and paperboard has been announced by Valchem. Because of its chemical structure and pliability, Acrival A-37 is claimed to give more specific adhesion to cellulose than the harder acrylic emulsions. Bonding strength is excellent. It is especially recommended where high tack inks are utilized in printing operations.

Acrival A-37 is supplied as a white, low viscosity emulsion with a 46% solids content. Brookfield viscosity is 20-40 cps. Coatings formulated with it may be applied by most standard coaters.

Readers' Service Item 2

Cold blending vinyl resin

Goodyear Tire & Rubber Co.'s chemical division has developed a blotter type, cold blending, general purpose PVC. The resin can be preblended at room temperature and will absorb a relatively high percentage of plasticizer.

Pliovic BL-80, a fine white powder, possesses the general properties typical of unmodified vinyl polymers. It has a bulk density of 28 pounds per cubic foot, a low gel level in plasticized compounds, and excellent heat stability. Blends of Pliovic BL-80 are reported to improve calendering operations by providing smoother banks and better release over a wide range of temperatures and conditions. Formulations with this resin do not require special stabilizer systems.

Because of high plasticizer absorption properties, BL-80 is suggested for baby pants, outer garments, jacket material, and upholstery sheeting. It can also be used in heavy gage material.

Other properties include an inherent viscosity of 0.98; specific gravity of 1.40; plasticizer absorption index of 60; and moisture content of 0.5%.

Readers' Service Item 3

Economical vinyl stabilizer

A stabilizer which reportedly will cut stabilization costs of vinyl compounders in half has been introduced by Allied Asphalt & Mineral Corp. Identified as Allied Y-3, the stabilizer can be used in both filled and unfilled formulations to prevent heat decomposition during processing or service. As well as serving as a heat and light stabilizer, Y-3 will also aid in wetting fillers and in lubricating mold or calender in extrusion or calendering operations.

Essentially a barium soap in composition, the stabilizer shows the following characteristics.

Softening point, ASTM E-28, °F., min.	280
Typical	300
Penetration, 77° F.	50-90
Color, Barrett, 2 gm./25 ml., max.	4
Acid number	30-50

Readers' Service Item 4

Protective polyester film

According to Goodyear Tire & Rubber Co., coatings based on Vitel polyester material will protect chrome and other metallic automobile trim against scratching and corrosion for a year. Vitel, produced in resin or pellet form, can be formulated into a clear or tinted liquid solution that forms a hard, glossy, protective film which can be washed with clear water. Coatings may be brushed or dipped, or may be adapted to spray applicators.

Readers' Service Item 5

Flame retardant laminate

A glass base, flame retardant, epoxy resin laminate has been developed by Spaulding Fibre Co. to meet the demand for a more easily fabricated material. Available in sheets 40 by 48 inches with thicknesses ranging from 1/32 to 1 inch, G-10-839 has a translucent green color. In 1/16-inch thicknesses, it can be sheared and punched with minimum heating. Typical properties of 1/16-inch sections follow.

Flexural strength, psi., lengthwise	66,000
Crosswise	60,000
Izod impact, ft. lbs./in., lengthwise	12.1
Crosswise	9.33
Tensile strength, psi., lengthwise	52,000
Crosswise	44,500
Compression strength, psi	52, 55 –
Specific gravity	1.90
Water absorption, %	0.10
Rockwell hardness, M scale	103
Dielectric breakdown, parallel to laminations, step by step, kv	52.2+

Readers' Service Item 6

PVC polymer

A low molecular weight vinyl chloride homopolymer, Trulon 630, is commercially available from Thompson Chemical Co. According to the producers, this compound features a very high capacity for plasticizer absorption, a low gel count, and a stability approaching that of high molecular weight resins. It may be processed with or without plasticizer, or be blended with such modifiers as acrylates, chlorinated polyethylene, and ABS polymers.

The resin is supplied as a white powder with a maximum moisture content of 0.5% and a specific gravity of 1.4. Generally, one gram of the powder will absorp 1.05 cc. DOP. Trulon 630 can be milled without sticking at temperatures up to 300° F.

Readers' Service Item 7

Thermosetting sand binder

Union Carbide Plastics Co. has developed a powdered, thermosetting sand binder for production of cold-coated sands suitable for both dump-box and blowing operations. Cold coating with Bakelite phenolic resin BRP-8875 is accomplished by the powder-alcohol process.

Characterized by short flow and fast curing rate, BRP-8875 is claimed to perform well over the temperature range normally used in shell and core molding. Shell molds and cores will release easily from patterns. They are dimensionally stable, and produce castings with good surface smoothness.

Readers' Service Item 8

Epoxy adhesive & hardeners

Epon adhesive 901, a solvent-free epoxy paste which can be cured with four liquid agents, has been introduced by the adhesives department of Shell Chemical Co. When the grey paste resin is mixed with any of the curing agents, the resultant adhesives are thixotropic even during cure

at high temperatures.

The four curing agents offer cure conditions from room temperature to 300° F., and will supply tensile strengths up to 3,800 psi. Agents A, B-1, and B-2 change color from grey to red when the paste and liquid have been thoroughly mixed.

Epon adhesives 901/A, 901/B-1, and 901/B-2 have pot lives of 2 hours, 50 minutes, and 30 minutes, respectively, at 75° F. Service temperature maximum for all three is 225° F. Curing agent B-3, a dark liquid, provides an adhesive with a 6-hour pot life at 75° F. and a cured service temperature of 350° F.

Readers' Service Item 9

Improved polycarbonate

A color stabilized grade of Lexan polycarbonate resin reported to offer improved appearance and optical qualities is now available from the chemical materials department of General Electric Co.

Lexan 101 has the same properties as the earlier 100, except that it will exhibit light transmittance values 5-10% higher because darkening during processing is prevented by a color stability additive. Use of the additive is expected to expand applications for polycarbonate resins in transparent and translucent parts, as well as permit more widespread use of regrind.

Readers' Service Item 10

Reinforced diallyl phthalates

Three reinforced diallyl phthalate molding compounds, each of which conforms with a government MIL specification, have been introduced by Rogers Corp. They are RX 1260, a self-extinguishing, mineral-filled, DAP compound; RX 1280, a high temperature, mineral-filled diallyl isophthalate compound; and RX 1380, a high temperature, fiberglass-filled isophthalate compound. All are reported to retain electrical properties after exposure to high humidity. The last two can be used at temperatures up to 500° F.

Both RX 1260 and RX 1280 are recommended for electrical and electronic components such as connectors, terminal boards, potentiometers, and computer program boards. The third material can be used for insulation and structural applications involving exposure to temperatures up to 500° F.

Readers' Service Item 11

Colloidal alumina

E. I. du Pont de Nemours & Co. has developed a powdery white alumina which, unlike other aluminas, disperses in water to form a stable colloid. The product, designated Baymal, is available only in experimental quantities, but is expected to find interesting applications in many industries.

One of these applications is the reinforcement of organic polymers which are water soluble, or at least water dispersible. In the case of water soluble hydroxyl polymers such as polyvinyl alcohol, cast films containing 10% Baymal reportedly exhibit large increases in strength and heat resistance. Use is similarly suggested in hydrolyzed polyvinyl acetate polymers and copolymers and in reactive methylol resins, such as urea-, phenol-, and melamine-formaldehyde.

Polymer reinforcement is possible becaus of the fibrillar structure of Baymal. This alumina consists of extremely small fibrils which have a high surface area. When a dispersion is dried from water, a film can result. If this film is formed in the presence of fibers such as glass, it gives a bonding or adhesive action at the junction of the larger fibers. Further, in dispersion Baymal will disperse asbestos or glass fibers. Applying a film of colloidal alumina will improve the thermal stability of a glass fabric surface. This may be of use in missile and other high temperature applications.

Fibrils assume a positive charge when dispersed. Therefore, Baymal can fix itself to negative surfaces, changing their charge to positive. It is both hydrophilic and organophilic.

When dispersed, this material becomes extraordinarily thixotropic and shows unusual characteristics. For example, a 4% solution can be changed from a very fluid solution to a very viscous sol through slight change in acidity. The time required for gelling can be tailored from less than a second to more than a day.

Readers' Service Item 12

Bronze plastisol pigments

The K-7500 series of permanent bronze gold pigments for vinyl plastisols and organisols has been developed by Claremont Pigment Dispersion Corp. According to Claremont, these pigments replace earlier bronze golds which, when compounded with vinyl dispersions, tarnished severely during heat curing and atmospheric exposure. They are recommended for fabric coatings, molded objects, and metal coatings, but should not be used in calendered or extruded products.

Three pigments are in the series: K-7533 is a deep gold, K-7522, a pale gold, and K-7511, a copper. In tests conducted on clear plastisols pigmented with 10% of each paste, there was no change in color after 400 hours in a Fadeometer, after 30 days immersion in water, or after ten minutes at 425° F.

Readers' Service Item 13

Reinforcing agents

A fiberglass cloth and asbestos fiber have been developed especially for use in reinforcing plastics.

The cloth, Rezolin, Inc.'s Drapeze #391 is 0.0283 inch thick. Designed for ease of laminating deep, sharp contour surfaces, it will form into and retain its position over a very sharp radius and deeply recessed area. It is reported to provide faster laminating, fewer layers at lower cost, and less interlaminar residual stresses in sharp contour laminates. Applications include close tolerance plastic tooling, patterns and equipment, boat construction, critical reinforced plastic parts, and structures of all types.

Readers' Service Item 14

Johns-Manville Corp. has developed Plastibest No. 20 for reinforced plastics. This chrysotile fiber is reportedly characterized by excellent finishing qualities, light color (light gray when wet; lighter when dry), high surface area, good reinforcing properties, high heat resistance, and excellent dimensional stability.

According to laboratory tests comparing moldings reinforced with ¼-inch sisal and Plastibest No. 20, the latter provided almost double the flexural strength and almost 1000% greater resistance to water absorption.

Readers' Service Item 15

Also Worth Mentioning

☐ Schwartz Chemical Co., Inc., has available parting agent EP to facilitate casting of epoxies and polyesters. The medium viscosity material, in fluorescent or colorless formulations, can be thinned with tap water for spraying. Film can be removed by stripping or with warm water.

Readers' Service Item 16

☐ A dip dye claimed to eliminate color shift during use has been announced by Midwest Technical Service. It can be used in dyeing and vacuum metallizing plastics. In vacuum coating, a single dye system may be used on high or low bake coatings.

Readers' Service Item 17

☐ Marlex TR-414 type III polyethylene has been tailored for use in coilable merchant pipe. The most flexible of Phillips Chemical Co.'s plastic pipe resin, it can be used in sprinkler systems, potable water systems, farm water lines, and jet wells.

Readers' Service Item 18

☐ Bonate CF-9070, a corrosion-resistant, fiberglass-reinforced, modified furfural alcohol resin, has been developed by Beetle Plastics of Crompton & Knowles Corp. Non-inflammable, the compound can sustain continuous operating temperatures to 300° F. It is claimed to be more corrosion resistant than polyesters.

Readers' Service Item 19

☐ A benzidine phenetidide, deep opaque toner has been developed by Sandoz, Inc., for use in printing and in dying plastics. Graphtol yellow 4766-0 is stable for one hour at 350° F. It is non-bleeding in polyolefins, but will bleed badly in vinyls.

Readers' Service Item 20

New Equipment

Rotating screw mixer

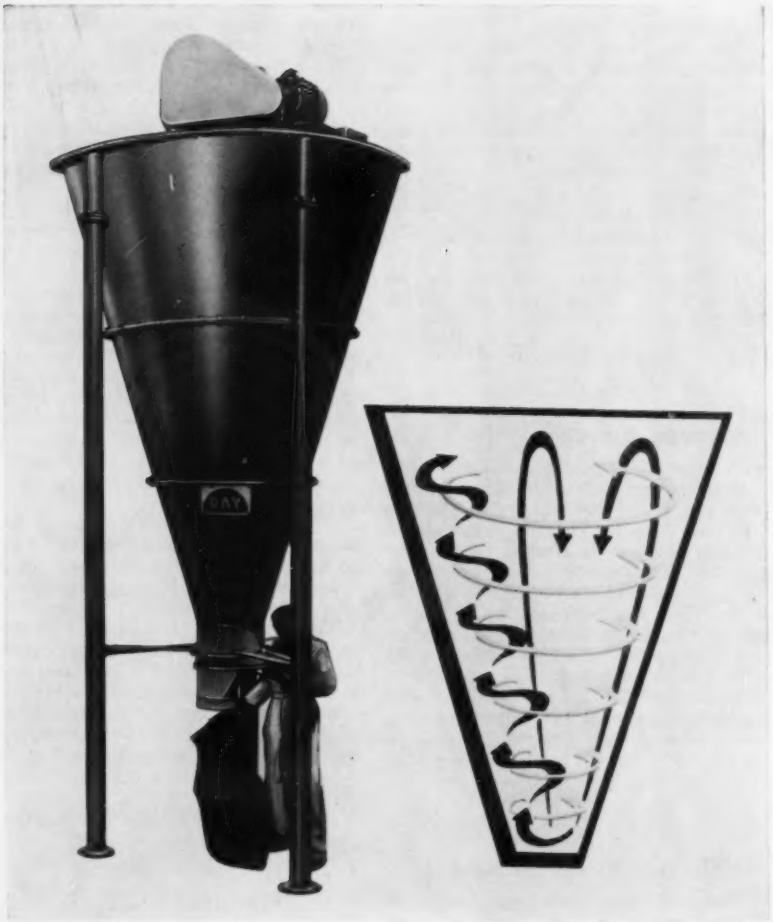
J. H. Day Co., has been granted license by NautaMix N.V. to manufacture and sell the Nauta mixer in the U. S. and Canada. The mixer is reported to provide higher accuracy mixing in a short time and to reduce heat generation to a minimum.

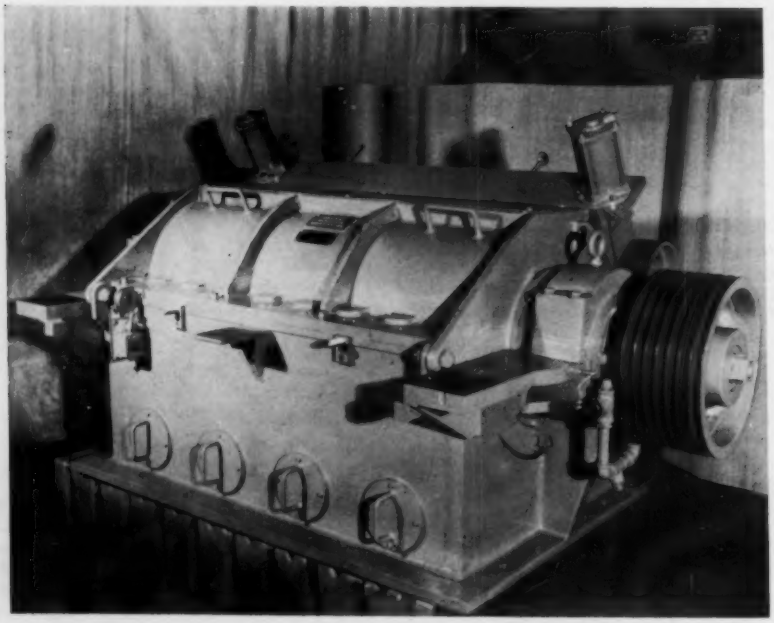
A three-way mixing action is accomplished by a rotating screw positioned along the wall of the conical container. As it revolves, the screw also orbits around the inside wall, resulting in vertical and horizontal spiral currents. After the material is lifted by the screw, gravity causes it to flow down the side of the cone. Material converges at the bottom quite forecefully. This three-current flow is reported to bring about accurate dispersion of one part in 10,000 within three minutes. Since contents of the container remain close together and are not whirled, differences in specific gravity and resistance to air do not influence the accuracy of the mix.

The mixer will start under full load, since the orbiting action of the screw is delayed until it has begun to rotate on its axis. A five hp. motor can mix a 4,000 pound batch.

For batches to which precise quantities of liquids are added during mixing, the Microjet injector can be used. Additions are made at the lower end of the cone.

Readers' Service Item 21





Film and sheet granulator

Sprout, Waldron & Co., Inc., has made available a rotary knife cutter designed for granulating roll fed scrap or sheets. The cutter will handle material up to 48 inches wide, and as thin as 1 mil. It is claimed that knife clearances can be held to 0.003 inch.

To maintain such accurate knife clearances, the machine must be rigidly and accurately constructed. The rotor cutting circle is 20 inches in diameter. Rotating knives, which are wedged-locked into position, can be sharpened by an integral knife grinder without removal from the machine.

According to the manufacturers, this design provides improved capacity per hp. and production, even from a wide sheet, of a uniformly cut product with better flow characteristics than previously obtainable.

Readers' Service Item 22

For more information check Readers' Service Card (p. 83)

Cowles dissolver for low to medium volume requirements.

Low-medium volume mixer

The Cowles dissolver model 515-VHV, a product of Morehouse-Cowles, Inc., can be used to mix and disperse such products as vinyl plastisols and organosols. Powered with a 10-15 hp. motor, it will handle 50-200 gallon batches with viscosities up to 50,000 cps. The impeller is 10-13 inches in diameter, as determined by motor size.

Hydraulic lift has a maximum rise of 42 inches with bridge length of 62 inches and width of 15 inches. Base dimension is 18 by 24½ inches. Speed range is 600-1,850 rpm.

Readers' Service Item 23

Die tooling equipment

Equipment developed by Sanders Tool & Production Co. is reported to speed spotting-in time during die and mold manufacture, testing, and repair up to 70%.

Tilt-A-Die consists of an elevating bed and lower platen which ride on four 4-

Sanders Tilt-A-Die, lower platen in working position.

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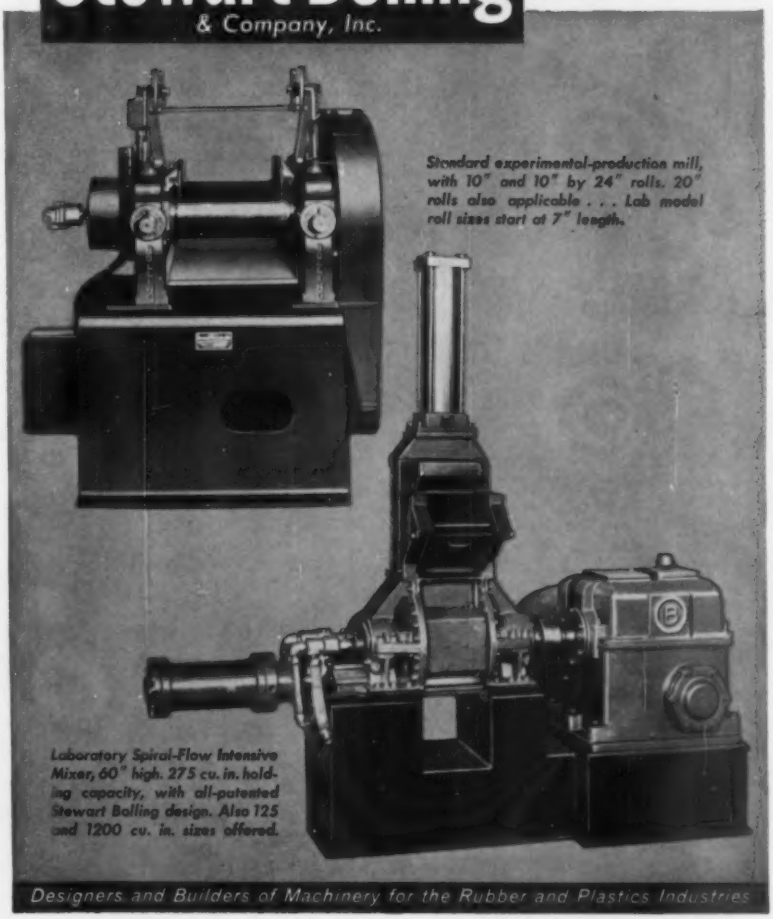


Standard experimental-production mill, with 10" and 10" by 24" rolls. 20" rolls also applicable . . . Lab model roll sizes start at 7" length.

Laboratory Spiral-Flow Intensive Mixer, 60" high. 275 cu. in. holding capacity, with all-patented Stewart Bolling design. Also 125 and 1200 cu. in. sizes offered.

Designers and Builders of Machinery for the Rubber and Plastics Industries

inch diameter guide bars. The crown is stationary. Die halves are secured to moveable platens and are rolled from the crown and bed to tilting position. They then can be hydraulically rotated (up to 220° from horizontal position) to the most efficient working position. After work is completed, dies and molds can be mated for repeated bluing-in operations. Under pressures of up to 130 tons per square inch, matching and alignment can be assured.

The Tilt-A-Die requires 64 square feet of floor space. Upper and lower platens are 30 inches wide, 50 inches long, and 3½ inches thick. Maximum space between them is 33 inches. Each has four ⅝-inch T slots.

Readers' Service Item 24

Polyethylene cube net weighing scale.

Polyethylene bagging scale

A net weight bagging scale for polyethylene cubes has been designed by Richardson Scale Co. Model E-52 has no dust-collecting ledges, shelves, or linkages to impede material flow from overhead supply into the bag. All material in contact with the polyethylene is stainless steel.

E-52 will bag ten 100-pound bags per minute. Although the scale is normally used with bags weighing 25, 50, and 100 pounds, other sizes are available.

Material is received through an inlet chute and control gate with flow, dribble, and closed positions. The material is completely confined during receiving, weighing, and discharge. When approximately 85% of the material has entered the hopper, the flow reduces to a dribble to assure accuracy. Thus, underweight and overweight bags need be no problem. Fastenings are welded to prevent pieces of metal from accidentally falling into the bag.

Readers' Service Item 25

Hartig blow molding package.

Blow molding package and pelletizer

Waldron-Hartig division, Midland-Ross Corp. has announced two products: a blow molding machine with a clamp force of five tons, and a line of underwater pelletizers.

Model 1412S-5 blow molder is especially suited for laboratory and experimental work, but can be used in production as well. Designed for fast platen closing under low pressure, high pressure is exerted only at the last ⅛-inch of platen travel. Free mold clamping area is 14 by 12 inches vertical. Longer molds can be used by extending them beyond the platen. Daylight opening is 6-20 inches. Actuated by two hydraulic cylinders, platens travel on three tie bars. The press is track mounted for mold positioning.

Parts as large in diameter as nine inches can be molded. While dry cycle time is three seconds, operating cycle depends on mold cooling and part ejection. Using a 16-ounce ram accumulator gives rapid parison extrusion, optimum parison uniformity and shot size, and less idle mold time.

The blow molder is used with the 2½-inch Hartig 25-T-20 extruder. The latter operates continuously with a nominal melt capacity of 150 pounds of 0.92 density polyethylene per hour at 130 rpm.

Readers' Service Item 26

The Hartig line of underwater pelletizers is for use with extruders from 2½ to 12 inches in size. Designed to compound and refine thermoplastic products into pellet form of excellent bulk density, it reportedly allows increased capacity in subsequent processing equipment. Output is rated at 100-7,000 pounds per hour.

The package includes pelletizer head with die body and plate, water circulation pump, water reservoir, vibrating screen separator, air heater, blower, cyclone separator, and auxiliary duct work. Controls are centralized at the pelletizer head.

Readers' Service Item 27

Underwater pelletizer.

Also Worth Mentioning—

☐ Mechanical assist, tip out, drum holder for its ¼, 1, and 2 hp. drum tumblers have been announced by Injection Molders Supply Co. The holders feature floor level loading with a three point cover lock and spring assisted lever lift.

Readers' Service Item 28

☐ Tapered objects up to 2¼-inch diameter can be marked at speeds to 100 per minute by a tapered tube imprinting machine developed by Markem Machine Co. Equipped with automatic feeding, imprinting, and ejection for assembly line work, the flexibility of the machine in adjusting to objects of various sizes and the use of quick-change inserts also make it practical for short runs.

Readers' Service Item 29

☐ Thwing-Albert Instrument Co. announces the #240-Alfa laboratory sample cutter. Electro-hydraulically operated, it will exert up to eight tons of pressure at the cutting surface.

Readers' Service Item 30

☐ A radiator-type, hydraulic oil cooler for use on injection molding presses of 2-16 ounce capacities is available from Injection Molders Supply Co. The cooler features two dial thermometers, ¾-inch connections, and reversible fan. Dimensions are 24 by 30 by 32 inches.

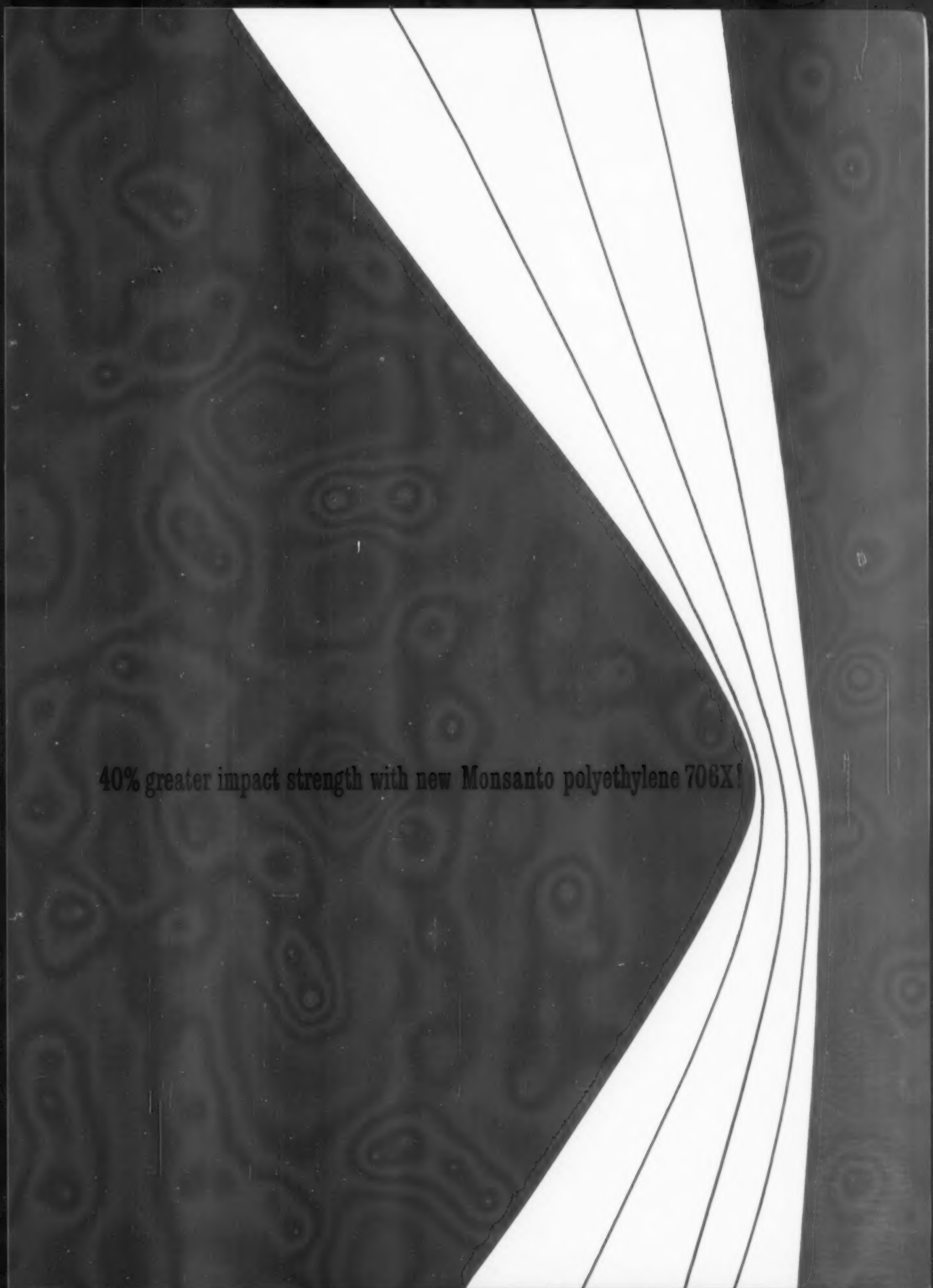
Readers' Service Item 31

☐ A miniaturized thermocouple assembly, Thrift/Therm, is supplied by Harco Laboratories, Inc., in four models. Temperature range is 0-2,000° F. Performance of the thermocouples is reported to equal or surpass that of more expensive equipment.

Readers' Service Item 32

☐ Comet Industries, Inc. has designed a press for trimming blisters, skin packages, and other vacuum formed products. The pneumatic die cutting press comes in two sizes, with trimming areas of 30 by 20 inches and 38 by 32 inches. A heated platen for heat sealing is optional.

Readers' Service Item 33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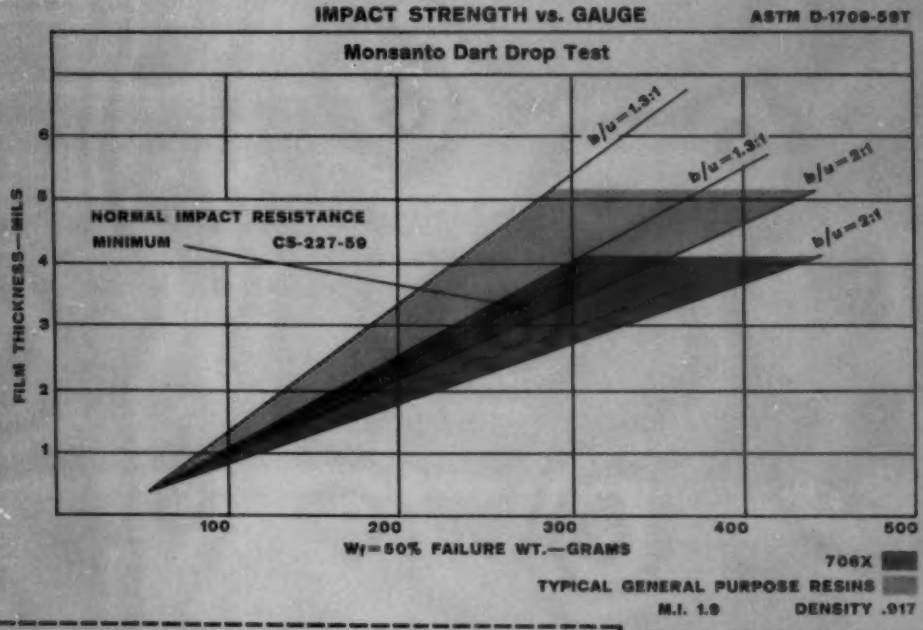
ANNOUNCING POLYETHYLENE 706X, a new super high impact film resin, for industrial packaging, construction and agriculture . . . *at no increase in price!* Film extruded from 706X has demonstrated 40% higher impact strength than film from any general purpose resin in the drop-dart test (See Chart). It is available in 4 degrees of slip, has the same physical appearance as regular 706, the same unique blend-to-blend, bag-to-bag uniformity, the same excellent and consistent processability, *and the same price!* Send coupon below for new Technical Service data sheet on MP 706X, to Monsanto Chemical Company, Plastics Division, Room 819, Springfield 2, Massachusetts.



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MONSANTO CHEMICAL COMPANY, Plastics Division. Room 819, Springfield 2, Massachusetts.

Please send me:

☐ 706X Data Sheet—Film and Resin information
☐ Names of leading suppliers of film made with 706X

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Plastics Applications

Nylon spray gun

A spray gun for the extermination industry composed primarily of glass-filled nylon, the Ban-Drip gun is reported by B. & G. Co. to be longer lasting, more efficient, and handier than spray guns of conventional design.

The design of the gun offers several advantages. If the handle is made of metal, the hose must be attached at the top near the nozzle. When nylon is used, fluid runs through the handle, and the hose is connected at the butt. Single unit design minimizes clogging and malfunction. Certain characteristics of the nylon, especially resistance to corrosion and pitting by exterminating fluids, also recommended it for this application.

Fiberfil Corp. supplies the nylon, Nylafil G-3, made of Plaskon nylon 6 (#8200). U. S. Gasket division of Garlock Packing Corp. molds the parts.

Readers' Service Item 41

Polyethylene minnow bucket

Fedco Corp. is molding a polyethylene minnow bucket that is noiseless, unsinkable, rustproof, and self-aerating.

The pail has a ten-quart capacity. A float chamber guarantees it will stay upright. Features include a lid that snaps on the bait section, an air chamber with pinhole bubbler, a minnow trap in the base, and an outer bucket which serves as a flexible bailing pail.

Readers' Service Item 42

Polyester-coated plywood

Videne, a thermoplastic polyester film, is laminated to plywood to provide the unusually damage-resistant surface of Weldwood Permagard, introduced by U.S. Plywood Corp. Developed by Goodyear Tire & Rubber Co., Videne is an extruded, unoriented material which will not shrink, crack, or craze with age. With a companion polyester coating it can be laminated under heat and pressure to any wood or wood composition materials in one step. No cure time is necessary.

Videne is laminated to the wood by the roll laminating process. After lamination according to Taber abrasion tests, the film shows less wear than even high pressure laminates. Its gloss varies from soft matte finish to glossy sheet depending upon the heat and techniques of lamination. On virgin woods, the film brings out the natural wood grain pattern. To achieve special decorative effects on inexpensive plywood and composition board, Videne can be reverse printed.

After processing, Permagard can be finished on regular wood working equipment. The finish is noted for stain and wear resistance. Further, it needs no waxing. Besides finding uses in wall and partition paneling, it may be used for such furniture as coffee tables, end tables, desks, and library tables.

Readers' Service Item 43

Women's safety glasses

Willson Products division, Ray-O-Vac Co., has designed attractive safety glasses for women workers. Wire core spatular temples are adjustable for permanent fit. Sheet stock frames and temples are of combustion resistant butyrate. The lenses, which come in two standard sizes, snap out for replacement.

These glasses come in two-tone or solid colors, and are available with sideshields.

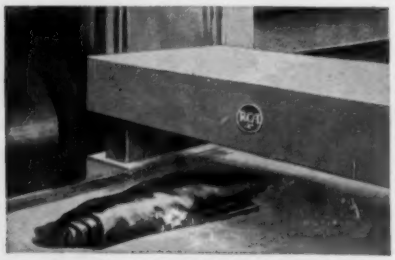
Readers' Service Item 44

For more information check Readers' Service Card (p. 83)

Protect your product and machinery with the RCA ELECTRONIC METAL DETECTOR

Tramp metal is a threat that no plant can afford. So, today, hundreds of plants are using this special electronic equipment to safeguard their investment in costly equipment and product. Highly sensitive, it automatically detects all kinds of metal, both magnetic and non-magnetic. Inspects powdered, bulk, sheet or packaged materials.

RCA Metal Detectors can quickly pay for themselves in your operation in longer machinery life, reduced downtime and increased profits. Get this protection at once. Write to RCA, Dept. W-410, Building 15-1, Camden, N.J.



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RADIO CORPORATION OF AMERICA

Plastics Applications (Cont'd.)

The Chal-A.

Foam panel cottage

Koppers Co., Inc., has devised a summer vacation cottage made of its Dylite foam core panels surfaced with plywood. Sold as an all-inclusive kit which can be assembled by the purchaser, the Chal-A is constructed on a simple platform foundation. Both interior and exterior plywood panels are primed and ready for finishing.

Building plans are available in four sizes, from 16 by 16 feet to 16 by 28 feet. All are 11½ feet high.

The Chal-A is marketed through the Dylite panel plant of Koppers.

Readers' Service Item 45

Plexiglas machine shield.

Machine tool guards

According to Dilley Mfg. Co., magnetically fastened machine tool guards of transparent plastic will effectively protect operators from possible injury by flying chips, splinters, dust, hot particles, and oil splash. These guards, consisting of a ⅛-inch sheet of Plexiglas with one or more Alnico magnets attached to the edge, will stay in place despite vibration. At the same time, their position can be adjusted easily.

The shields, which range in size from 6 by 8 inches to 16 by 20 inches, afford a clear view of the work and machinery. They are intended to augment, rather than replace, goggles and other personal safety equipment.

Readers' Service Item 46

Cast epoxy rod

Boonton Molding Co. is supplying cast epoxy rod for use in electronic winding forms. It is reported to meet the specifications for precision wirewound resistors under MIL-R-93B.

BMCO 2000 series comes in standard colors and diameters, with a wide selection of types and percentages of inert fillers. The rods, which can be machined with conventional shop techniques, show a volume resistivity of 0.19 x 10^{16} at 180° C., and a heat distortion temperature of 133° C. at 264 psi.

Readers' Service Item 47

Toymaster telephone receiver.

Toy telephone handset

Chanal Plastics Industries is blow molding a 7¼ by 2 inch toy telephone receiver from black linear polyethylene. Featuring undercuts on the ear and mouth section, the receiver is molded on a 50 mm. Kautex blow molding machine for Toymaster Products.

This type of product had previously been injection molded in two pieces.

Readers' Service Item 48

Carburetor fuel inlet valve

By using a Viton-tipped fuel inlet valve, Holley Carburetor Co. has solved the problem of carburetor flooding because of foreign particles in the fuel. Viton, a DuPont fluoroelastomer, provides perfect sealing of the valve and seat despite contaminants in the fuel. It will be available on new equipment as well as for replacement.

Readers' Service Item 49

Polystyrene components

Central Vacuum Corp. has developed a central vacuum cleaning system and an oral evacuation apparatus, both of which employ high impact polystyrene for major components. In both cases, Dow Chemical Co. supplies Styron 440 to the molders, Plas-Tex.

The cleaning system, named Central Vac, is installed in homes, hotels, and office buildings. It has a single suction unit. Metal inlets mounted in the walls of the building connect the 28-foot flexible hose to the piping which leads to the 7-gallon disposal bag.

Plastics Applications (Cont'd.)

Use of polystyrene enable reduction of the number of parts in the power unit from 101 to 21. Other reasons for its choice was that it could simplify installation, resist corrosion, eliminate several finishing operation, and lighten weight.

Hose and attachments for Central Vac.

Readers' Service Item 50

The Central Vac-uator for oral evacuation consists entirely of Styron 440. It is designed so that the power unit is located in a remote office, with only the hose and evacuator handpiece in the operating room. Since each handpiece can be equipped with individual controls, one unit can serve several operatories. Because the power unit drains directly into the waste line, there is no danger or mess from contaminated waste.

Central Vac-uator hose and evacuator handpiece.

Readers' Service Item 51

RP computer cover

The reinforced plastic cover slected by Monroe Calculating Machine Co. for its Monrobot Mark XI general purpose electronic computer eliminates many assembling difficulties usually found with metal castings. The fiberglass-reinforced polyster cover is formulated and molded for Firmaline Products, Crompton & Knowles.

Among the several advantages of the reinforced plastics covers is their uniformity. In comparison with the previously used aluminum castings, they will bend slightly and can be drawn into shape against a part which might be out of tolerance. The reinforced covers cost 50% less than aluminum covers, have high impact resistance, minimize finishing problems, and ease tooling problems.

Readers' Service Item 52

Industrial PE cartridge

Hydrocarbon Chemicals, Inc., is producing a high density polyethylene cartridge for photocopy machines. The cartridge stores an 8-10 week supply of ready mixed developer fluid in Smith-Corona Marchant photocopiers. It automatically draws fluid away from the processing unit when the machine is not in use.

Blow molded developer cartridge.

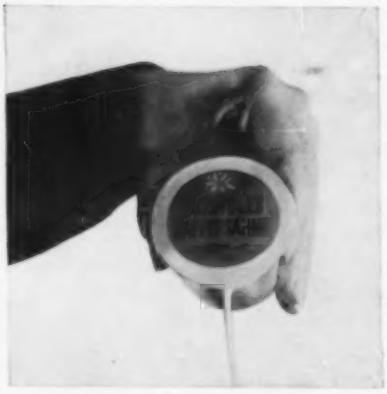
Marlex high density polyethylene, a product of Phillips Chemical Co., comprises the blow molded container.

Readers' Service Item 53

Recloseable package

A novel package for liquids and pastes can be produced, filled, and sealed on the Formseal machine sold by Hydro-Chemie Ltd.

The package consists of a container and flat preprinted lid. The two are sealed together so that a double flap with an unsealed space is formed. The flap can be cut open or torn along a tear line. When the container is gently squeezed, the flap forms a spout through which the contents can be poured.



Closeable package with flap removed.

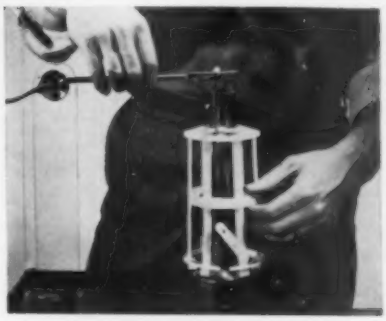
Since the container can be closed by pressing the spout back, this pack is ideal for such products as cream, sauces, oils, and others which are not used up upon first opening. The size and, to a certain extent, the shape of the package can be selected. Maximum volume is ½ pint.

Readers' Service Item 54

Flush toilet equipment

Du Pont has announced a polyethylene tank ball and guide that stops leakage and drips in flush toilet tanks. Manufactured from Alathon polyethylene by Valguard Co., Inc., it can be installed without any tools.

The unit can be fitted to overflow pipes of varying diameters, and is compatible with any flushing mechanisms. The polyethylene ball retainer automatically centers over the flush valve, seating the rubber ball on the valve in perfect alignment. Included in the kit is a Monel side-joint, kink-proof chain and bolt to connect the ball with the trip lever handle arm.



Toilet tank ball and guide.

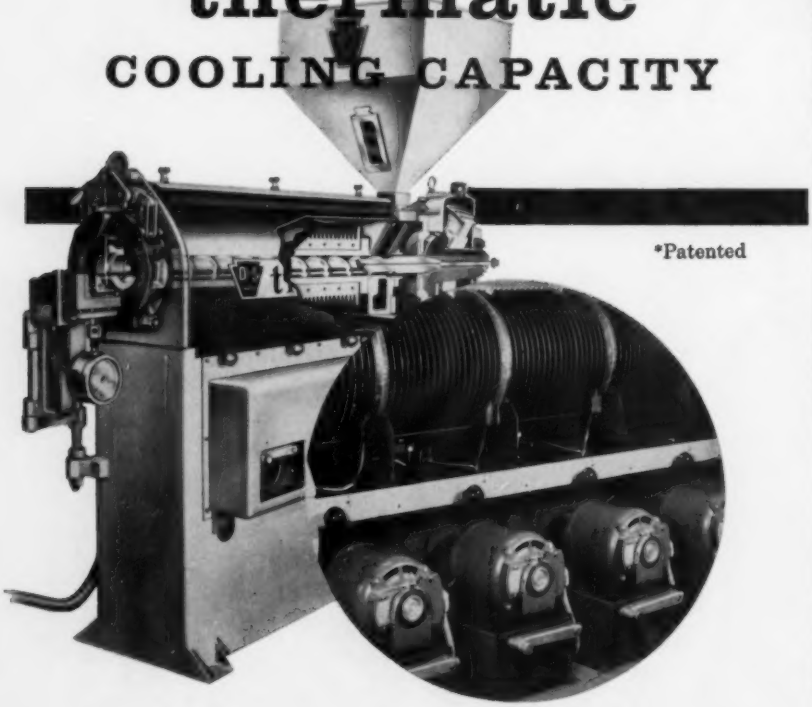
Readers' Service Item 55

ABS piano hinge

A continuous, piano type hinge of Cycolac ABS plastic has been introduced by Industrial Specialties. The standard eight foot length weighs four ounces. For additional frictional advantages, the hinge

SOONER OR LATER

BLOW MOLDERS WILL NEED thermatic* COOLING CAPACITY



*Patented

Suppose you run linear polyethylene of low melt indices from .2 to .4 . . .

D-S Thermatic cooling capacity permits lower stock temperature of the extruded tube for faster mold cycles.

On dry color blending–a competitive necessity–high screw speed for compounding is unlimited by temperature control problems due to the cooling capacity of the D-S Thermatic.

Don't lose time and money on special stock screws and slow production rates when what you really need is THERMATIC COOLING CAPACITY

D-S DAVIS-STANDARD thermatic
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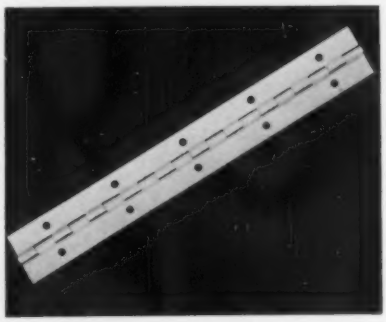

Continuous piano hinge.

contains a nylon pin. Thus, no lubrication is necessary.

The hinge can be used in aircraft and electronic equipment, as well as underwater. Cycolac material is supplied by Marbon Chemical.

Readers' Service Item 56

Also worth mentioning—

☐ Two of Fiberite Corp.'s formulations are combined in molded rocket motor exhaust tubes on the Polaris missile. Compound MX2625 is used for superior mechanical strength and compound MX-2630-A-67 for ablation resistance.

Readers' Service Item 57

☐ Vinyl rain boots with spike-proof heels have been introduced by Principle Plastics Co. The boots are fashioned of Reziltuf, a material based on B. F. Goodrich Chemical Co.'s Geon vinyl. Drizzle Boots have a metal shield imbedded in the sides and bottom of the boot heel to prolong their life.

Readers' Service Item 58

☐ According to Chemplast, Inc., hollow spheres of Teflon can provide a high degree of flotation in corrosive fluids; a four-inch diameter ball will support a ¾-pound weight in water. The roundness, light weight, and resiliency of these balls indicate applications in ball check valves, flow meters, float valves, and float level indicators.

Readers' Service Item 59

☐ Ice suckers are being sold in a plastic laminate pouch for home freezing. Inasmuch as the suckers do not have to be refrigerated during transport and storage, they are considerably cheaper than prefrozen pops. Narrow pouches, containing two ounces of fruit—flavored liquid, are made of 2½-mil Petrothene 205-15 polyethylene extruded over reverse printed cellophane by Modern Packaging Co. When the suckers are removed from the home freezer, the pouches are simply peeled off.

Readers' Service Item 60

New Literature

For more information check Readers' Service Card (p. 83)

"Design of Floating Structures with Styrofoam." A.I.A. File No. 32-B (NN). Dow Chemical Co. 24 pages. Discusses advantages and limitations of using foamed polystyrene as a flotation material. Follows with design data and installation directions and precautions. Finally, there is a section indicating behavior of Styrofoam in the field.

Readers' Service Item 61

"Engineering and Molding Data on Kralastic MM." Bulletin No. 3-A. Naugatuck Chemical division, U. S. Rubber Co. 12 pages. Uses, features, and properties of this ABS resin are expressed in text, illustrations, tables, and graphs. Directions are supplied for processing and post molding operations.

Readers' Service Item 62

"Bakelite Vinyl Resins for Solution Coatings." Union Carbide Plastics Co. 34 pages. Information on properties and uses, formulations and preparation of clear and pigmented vinyl-based coatings, and methods of application. Tables list suitable pigments and soluble dyes.

Readers' Service Item 63

"Dapon Diallyl Phthalate Resin Varnishes." Bulletin No. 32. Dapon department, Food Machinery and Chemical Corp. 8 pages. Formulation and use of DAP-based varnishes for coating, sealing, dip encapsulating, and laminating. Table of properties of unfilled resins.

Readers' Service Item 64

"Marvinol VR-50." Naugatuck Chemical division, U. S. Rubber Co. 20 pages. Characteristics and formulations for this all purpose PVC stir-in paste grade resin for high shear plastisol and organosol applications. Includes illustrations of equipment, graphs of properties, and basic starting point recipes.

Readers' Service Item 65

"All About Polyethylene Pipe." Union Carbide Plastics Co. 8 pages. Intended to explain quality, type, density, and proper application of polyethylene pipe to the contractor. Discusses Commercial Standard CS197-60 and National Sanitation Foundation requirements, as well as installation procedures.

Readers' Service Item 66

"Clear Visolyte Film." Visking Co. 4 pages. Features of this biaxially oriented polystyrene films are explained. Specifications and suggested applications.

Readers' Service Item 67

"Rubber and Plastics Machinery: Hydraulics Section." Part I, Edition 23. Stewart Bolling & Co. 32 pages. Describes a broad range of hydraulic presses. New features include mat presses, a breech block, and open-side presses.

Readers' Service Item 68

"Micarta Polyesters." Bulletin B8216. Micarta division, Westinghouse Electric Corp. 8 pages. A guide to water resistant, glass mat, polyester laminates and molding compounds for Class B insulation applications. Bulletin emphasizes features and physical and electrical properties of 13 grades of laminates and molding compounds.

Readers' Service Item 69

"1961 Plant Equipment Catalog." Injection Molders Supply Co., Inc. 72 pages. This catalog contains data sheets on all IMS standard stock items. Includes specifications, illustrations, and prices for such items as tumblers, grinders, ovens, and nozzles.

Readers' Service Item 70

"Polyester Resin Selector." Plastics and resins division, American Cyanamid Co. 10 pages. Describes characteristics, fabricating procedures, and end uses of 24 standard Laminac formulations. Grouped by performance.

Readers' Service Item 71

"Polyester Resins for Spray-Up Application." Plastics and resins division, American Cyanamid Co. 6 pages. Covers operating techniques, safety procedures, coloring, and measuring Laminac 4106 and 4152 for spray-up. A catalyst concentration chart indicates proportion of catalyst to different quantities of resin.

Readers' Service Item 72

"Injection Molders Handy Reference Charts." Injection Molders Supply Co., Inc. 3 pages. Three charts on card stock for mounting; amperage conversion table, grams into ounces conversion chart, and number of pieces in pounds based on weight of one piece in grams.

Readers' Service Item 73

"Acrylonitrile." Union Carbide Chemicals Co. 25 pages. Reactions, applications, properties, and test methods. Value graphs. Can be used in elastomers and plasticizers.

Readers' Service Item 74

"Comparison Chart Brochure." Marbon Chemical division, Borg-Warner Corp. 12 pages. Compares and evaluates major properties of nine plastics with multi-color bar charts. Covers cubic inches per dollar, heat deflection temperature, impact resistance, tensile modulus, and hardness.

Readers' Service Item 75

"Grab Bag of Profitable Polyethylene Packaging Ideas." Packaging with Plastics, Vol. 7, No. 1. Union Carbide Corp. 12 pages. This issue covers novel packaging ideas, reviews of lab reports, etc.

Readers' Service Item 76

"Blow Molding Plastic Shapes from Design to Finished Product." Dewitt Plastics, Auburn, N. Y. This blow molding primer covers functions and limitations, materials, economies, and design.

Readers' Service Item 77

"Ballasts for Plastic Sign Applications." GEA-7125A. General Electric Co. 8 pages. Specifications of ballasts for outdoor use. Wiring diagrams. Obsolete ballasts and suggested replacements.

Readers' Service Item 78

"Plastics for Lighting." Holophane Co., Inc. 6 pages. Tabulates comparative properties of three resins for lenses. Amplifies most important properties in text. Illustrates light diffuser styles.

Readers' Service Item 79

"New Developments in Vacuum Metallizing." Bee Chemical Co. 4 pages. Depending upon the surface and property desired, systems and methods of coating and thinning are outlined, with properties. Includes methods of application and base and top coats.

Readers' Service Item 80

"Plastic Extruders, Dies, and Auxiliary Equipment." Bulletin HK-10. Hale and Kullgren plastics department, Black-Clawson Co. Bulletin describes and illustrates the line of Aetna-Standard induction heated extruders and related equipment. Specifications and schematic diagrams.

Readers' Service Item 81

"Multi-Point Controllers." Instrument Section 52. Thermo Electric Co., Inc. 8 pages. The instrument can provide two-position control of 10 processes; three-position control of 5 processes; or constant control of a single process. Detailed information on applications of bridge or potentiometer circuits, installation, operation, and maintenance.

Readers' Service Item 82

Book Reviews

"Infrared Radiation." Henry L. Hackforth. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Cloth, 6 by 9¼ inches, 303 pages. $10.00.

Anyone interested in infrared radiation applications will find this book of interest. It deals not only with applications, however, but with the nature, characteristics, and physics of infrared radiation as well. Trying to avoid mathematics as much as possible, the author introduces infrared radiation on an elementary level. Following the first chapter, however, the material becomes necessarily somewhat more complicated. The author supplies, for background information, material on physics; infrared radiation sources; atmospheric transmission of infrared radiation; optical components, systems, and materials; infrared detectors; and infrared system design considerations. The second chapter develops a model of a generalized infrared system, used throughout the book, which traces the path of a signal from its source to final recording or display. Since each system must be tailored for a specific job, the example is necessarily general.

The second half of the book applies the fundamental concepts of infrared radiation to setting up instruments and using them. The final three chapters cover applications of IR in the sciences, in industry, and in space technology.

"An Outline of United States Patent Law." Richard E. Brink, Donald C. Gipple, and Harold Hughesdon. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6 by 9¼ inches, 280 pages. $7.50.

The authors have attempted to present a logical outline of data related to obtaining a patent and enforcing the rights granted under it. They have selected the data from *Title 35 of the United States Code, The Rules of Practice of the United States Patent Office in Patent Cases,* and the *Manual of Patent Examining Procedure.* For convenience, the appendices include copies of *Title 35* and *Rules.*

By means of a reference system, each entry in the outline can be located in the original documents, The index seems complete, and each item which appears more than once is indicated in the text with an asterisk.

The book is not a replacement for standard legal works, in that there is no case documentation.

"Automating the Manufacturing Process." George F. Hawley. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 6 by 9¼ inches, 147 pages. $4.95.

This easy-to-read volume, on a level which can be easily comprehended by non-technical management as well as engineering personnel, attempts to explain the why's and how's of automation in manufacturing.

As the author points out, automation is not always advisable, or even necessary. On a short-lived product, which may no longer sell well in a year or two, installation of automatic machinery might well be foolhardy. What the manufacturer must do is to estimate all expenses and possible savings involved in automation, and then call in a contractor to see whether it is the best thing. In the long run, automation may save money. However, its period of use must be sufficient to amortize costs. Since design of automatic machinery is usually done for a specific job, the manufacturer can not be sure that it will work when installed. Therefore, he must choose his contractor and state his aims with care.

The book carries the reader through the steps of selecting a contractor, deciding on method of payment, designing and building a prototype, testing it in action, and debugging. For each of these topics, he presents a generalized introduction, followed by a specific example. Most of the examples are concerned with feeding mechanisms.

Not only does the author cover the technicalities of automation, but he is careful to emphasize the human point of view. Employees can easily learn to resent a machine which may replace some of them. What the manager must do is to set the employee's frame of mind so that he will "love" the machine. Further, the author is concerned with the attitudes of different employees concerned in producing the machine. He discusses the possible problems which may be suggested down the line, if, for example, the machine shop men would like to switch the design in some way.

The contents of the book is good, but elementary. It is recommended as a supplement to more comprehensive books on the subject, which cover more of the basic engineering formulae.

"Compression and Transfer Moulding of Plastics." J. Butler, Interscience Publishers, Inc., 250 Fifth Ave 1, N.Y. Cloth, 5½ by 8½ inches, 240 pages. $5.75.

Written by a well-experienced mold designer, this detailed, practical volume is intended for mold designers and mold shop executives. It is part of a series of monographs originally published by the Plastics Institute, London, for its members, and now being reissued for general circulation. The section on transfer molding is taken almost entirely from the earlier monograph, with some revisions and new chapters. The section on compression molding, although newly written, does not take into consideration all of the latest developments in the field. The author does not go into automatic molding; nor does he cover inlaying or precision molding.

Since the author feels that mold design is the most important element in compression and transfer molding processes, he spends much time illustrating and discussing different types of molds. Emphasis is placed on design for molding melamine, phenol, and urea formaldehyde resins. Throughout the book, the author explains all terms clearly. Also, wherever he thinks them helpful, he supplies cut-out, schematic, and line drawings plentifully. The photographic plates are very old.

Treatment of mathematical problems is good, e.g., vector analysis of force relationships in split die work.

The first half of the book, compression molding, covers mold types, relation of mold design to molding, cavity treatment, common cavity molds and molding, three-plate molds, other mold types and problems, molding procedures, and preheating. In the section on transfer molding, the author discusses the history of molding problems, transfer mold design, feed systems and gate areas, gate position and feed size, effect of transfer on strength of moldings, transfer and clamping pressures, split die problems, high frequency preheating, types of molds, and bolster strains and stresses.

"Chemical Processing Nomographs." Dale S. Davis, Editor. Chemical Publishing Co., Inc., 212 Fifth Ave., New York, N. Y. Cloth, 6 by 9½ inches, 255 pages. $12.00.

The nomographs in this volume were selected from those published in *Chemical Processing.* The object was to have a collection which would be of greatest general usefulness to chemists and chemical engineers in the chemical processing industries. Detailed instructions on using the 165 nomographs included are supplied.

This extremely practical book provides working directions without theory. Each nomograph is explained and supported with equations, examples of application, and references. Graphical anamorphosis is also included.

The first section provides directions on making nomographs, and includes such items as a modulus chart, addition and subtraction charts, multiplication and division charts, and line coordinate charts. From this, the chapters proceed to present nomographs on heat, flow of fluids, pulp mill calculations, vapor pressures, pressure-volume temperature relationships, solubilities, densities and specific gravities, viscosities, relative humidity, costs, sizing of equipment, conversions, and standard deviations and quadratic equations.

Patent Digest

Materials

Composition Comprising Cellulose Ester and Diisocyanate Modified Polyester Amide. No. 2,970,970. J. H. Prichard, Springfield, N. J. (to Celanese Corp. of America, New York, N. Y.).

Composition of a Monoepoxide Modified Polyamide and an Epoxy Resin. No. 2,970, 971. I. Katz, Long Beach, J. C. Wilson, Compton, and R. W. Jenkins, San Diego, Calif.).

Process for Preparing Linear Polyesters Involving Interchange Between a Glycol and a Dialkyl-Ester of a Dicarboxylic Acid in the Presence of a Tertiary Amine. No. 2,970,986. D. W. Woodward, Little Silver, N. J. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Copolymer Having Amide and Urethane Linkages. No. 2,970,987. E. L. Wittbecker, W. Chester, Pa. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

New Fluorine-Containing Polymers and Preparation Thereof. No. 2,970,988. E. S. Lo, Elizabeth, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

Vinyl Resin Compositions Stabilized with Acyl Borates. No. 2,969,342. O. Konig, Forest Hills, and E. G. Gordon, New York, N. Y., and D. F. Herman, Orange, N. J. (to National Lead Co., New York, N. Y.).

Polyester-Urethanes Derived from Dialkylmalonic Compounds and Textile Fabric Coated Therewith. No. 2,970,119. J. R. Caldwell, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Cellular Polyurethane Resin and Process of Preparing Same. No. 2,970,118. C. L. Wilson, Sloatsburgh, and H. G. Hammon, Piermont, N. Y. (to Hudson Foam Plastics Corp., Yonkers, N. Y.).

Stable Polyurethane Latex and Process of Making Same. No. 2,968,575. J. E. Mallonee, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Foamed Carbamide Resins and Method of Preparing Same. No. 2,970,120. W. H. Kreidle, New York, N. Y., and O. Vieli, Razuns, Switzerland (to Vereinigte Chemische Fabriken Kreidle, Rutter & Co., Vienna, Austria, and Spumalit-Anstalt, Vaduz, Liechtenstein).

Stabilized Polypropylene with an A-Stage Para-Tertiaryalkylphenol-Formaldehyde Resin. No. 2,968,641. J. S. Roberts and J. K. Ross, S. Charleston, W. Va. (to Union Carbide Corp.).

Polycarbonate Process, No. 2,970,131. W. W. Moyer, Jr., New Brunswick, J. Wynstra, Berkeley Heights, and J. S. Fry, Somerville, N. J. (to Union Carbide Corp.).

Treatment for Stabilizing Polymerized Olefins Prepared with Catalytic Metal Compounds. No. 2,967,857. C. R. Pfeifer and R. O. Whipple, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Process for Preparing Normally Crystalline Vinylidene Chloride Polymers. No. 2,968,651. L. C. Friedrich, Jr., J. W. Peters, and M. R. Rector, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Compositions and Methods for Curing Epoxy Resins. No. 2,967,837. J. Greenfield, Lake Hiawatha, N. J. (to Tung Research and Development League, Lyndhurst, N. J.).

Graft Copolymer of Polyethylene and Polymerizable Acrylic Compounds, Process for Preparing Same, and Composition Thereof. No. 2,970,129. F. M. Rubb and J. E. Potts, W. Caldwell, N. J. (to Union Carbide Corp.).

Epoxy Resin Composition Having High Heat Stability. No. 2,967,843. J. Delmonte, Glendale, and F. N. Hirosawa, Los Angeles, Calif. (to Furane Plastics, Inc., Los Angeles, Calif.).

Process of Coating a Polyethylene Substrate with a Vinylidene Coating and Resultant Article. No. 2,968,576. T. W. Keller and C. W. Garvin, Council Bluffs, I. and J. G. McMillan, Omaha, Neb. (to Howard Plastics, Inc., Council Bluffs, I.).

Plastic Cement Composition for Lightweight Ceramic Tile. No. 2,970,124. F. E. Drummond, Washington, D. C.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Equipment

Film Casting Apparatus. No. 2,965,927. A. L. Crosby, Austin, and K. M. Stoll, Port Allegany, Pa. (to Sylvania Electric Products Inc., Wilmington, Del.).

Molding Machine. No. 2,967,328. R. K. Shelby, Hinsdale, and G. A. Creevy, Villa Park, Ill. (to Continental Can Co., Inc., New York, N. Y.).

Manufacture of Hollow Inflated Plastic Objects. No. 2,967,329. S. Freidland, Highfield, Upton, Macclesfield, J. W. Sutton, Macclesfield, J. Doggart, High Trees, Titierington, Macclesfield, and D. F. Barton, Congleton, England (to V. & E. Plastics Ltd.).

Apparatus for Use in Manufacturing Plastic Faced Building Units. No. 2,970,-410. W. G. Gittins, Ladue, Mo. (to Volz Aristocrat Plastics, Inc., St. Louis, Mo.).

Clamping Frame for Vacuum Forming Parts. No. 2,968,064. G. H. Howell, Birmingham, Mich. (to General Motors Corp., Detroit, Mich.).

Screw Press for Extruding Plastic Materials. No. 2,968,836. R. Colombo, Turin, Italy (to S. A. S. Lavorazione Materie Plastiche (L.M.P.) di M. I. Colombo & C., Turin, Italy).

Process and Apparatus for Producing Sheets of Thermoplastic Material. No. 2,968,334. B. H. Pedersen, 15 Norske Alle, Holte, Denmark.

Continuous Mill. No. 2,968,832. A. Halve, Akron, B. A. McClellan, Mogadore, and R. L. Guggenheim, Cuyahoga Falls, O. (to Blaw-Knox Co., Pittsburgh, Pa.).

Extruder with Adjustable Choke. No. 2,970,341. E. E. Mallory, Cuyahoga Falls, and E. E. Heston, R. H. Kline, and R. L. Christy, Akron, O. (to National Rubber Machinery Co., Akron, O.).

Apparatus for Making Wound Plastics Structure. No. 2,970,343. W. T. Johnson and F. R. Barnet, Kensington, Md. (to U. S. A., Secretary of the Navy).

Article Abstracts

Materials

"Flexural and Impact Variations of Phenolic Moldings," C. Elmer and E. C. Harrington, Jr., ASTM BULL., No. 249, 35 (Oct. 1960).

A statistical round-robin study on methods of specimen preparation.

"Block and Graft Polymerization of Polymethyl Methacrylate under the Influence of Co_{60}-Gamma Rays," D. Hummel and C. Schneider, KUNSTSTOFFE, 50, 8, 427 (Aug. 1960).

Using irradiation techniques, block and graft copolymers have been prepared in which the main chain consists of polymethyl methacrylate and the side chains of polyacrylonitrile or polymethylacrylate. The behavior of the copolymers in the presence of solvents is described. Infrared spectroscopy was used in analyzing the materials.

"Epoxy Resins in Repair of Concrete Pavements," H. W. Goldberger, CANADIAN PLASTICS, p. 40 (Aug. 1960).

How patching materials based on epoxy resins are used by the N. J. Turnpike Maintenance Department for repairing concrete pavements.

"Facets of Laminated Plastic Sheet Application," J. E. Hyler, APPLIED PLASTICS, 3, 8, 41 (Aug. 1960).

A brief, generalized review of sheet applications.

"The Measurement of Exotherm Characteristics and Their Application in Epoxide Resin Casting Systems," G. R. Edwards, BRIT. PLASTICS, 33, 5, 203 (May 1960).

A new method of measuring the reactivity of epoxide resin/amine blends makes use of the so-called effective reactivity curve," shown to be a fundamental property of the system being tested. Relatively simple to determine, this curve is used to predict in a rational manner the curing behavior of a casting system under various conditions.

"Coloring Linear Polyethylene," P. E. Campbell, R. J. Martinovich, and T. V. Gay, SPE J., 16, 9, 1052 (Sept. 1960).

Three simple tests are given to decide on pigments for migration, fading, and heat stability.

"Glow-strength of Insulation Materials," H. Suhr, KUNSTSTOFF-RUNDSCHAU, 7, 5, 216 (May 1960).

"Glow-strength" is the term suggested by Potthoff to indicate the property of insulating materials to resist glow stresses, the word "corona" being reserved for phenomena in the field of high and maximum tension techniques. The author discusses the effect of glow on solid insulating materials and the glow starting and extinction voltages of these materials. Various tests already in use or that have been suggested are described, and a tentative classification of insulation materials by their glow strength is offered. (In German.)

"Porous Plastic Laminates," J. T. Hill, SPE J., 16, 9, 1047 (Sept. 1960).

Test results on preparing void-free, complex-shaped laminates.

"An Evaluation of Some Low Density Sandwich Laminates," L. H. Vaughan, PLASTICS (LONDON), 25, 275, 344 (Sept. 1960).

Test results show that properties of sandwich laminates are more affected by processing techniques than are ordinary laminates.

"Polypropylene, Its Properties and Processing Characteristics," W. L. Dunkel and R. A. Westlund, SPE J., 16, 9, 1039 (Sept. 1960).

A discussion of physical and permeability properties of polypropylene, and its use in injection molding, extrusion, thermoforming, and filament processes.

"Effects of Thermal Environment on Laminated Plastics," S. W. Place, INDIAN PLASTICS, p. 49 (April-May 1960).

A brief review of effects on thermal, electrical, and wear properties.

"Roll Leaf Stamping," M. A. Olsen, SPE J., 16, 9, 1056 (Sept. 1960).

A brief discussion of design, molding, and roll leaf formulations.

"Recent Developments in Polymers and Plastics," T. V. Subba Rao, INDIAN PLASTICS, p. 35 (April-May 1960).

A review of recent developments in high polymers.

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in September. The last listing appeared in the May issue.

"Plastics in Art," Harry Barron, RUBBER & PLASTICS AGE, 41, 9, 1033 (Sept. 1960).

A short column on plastics in painting.

"The Use of Secondary Plasticizers in PVC Plastisols," R. Reichherzer, KUNSTSTOFF-RUNDSCHAU, 7, 5, 222 (May 1960).

Results are described of tests on the effect of the secondary plasticizer, Lipinol SV, on the viscosity, gelation and aging of pasts from Halvic PVC and DOP. (In German.)

"Factors Affecting the Bursting Behavior of PVC Pipe at Elevated Temperatures," A. A. Van Der Wal, PLASTICS (LONDON), 25, 75, 361 (Sept. 1960).

Test results are given on the effect of HDT on bursting strength.

"Strength of Joints in Reinforced Polyester," J. Leeuwerik, G. J. Spies, and H. A. Bak, PLASTICS (LONDON), 26, 281, 141 (March 1961).

A test is described for determining lap joint strengths.

"Polyurethane Foams," T. T. Healy, APPLIED PLASTICS, 4, 3, 32 (March 1961).

Discussions of polyester and polyurethane foams.

"What's New in Foam Plastics," M. W. Riley, MATERIALS DESIGN ENG., 53, 3, 119 (March 1961).

A review of developments in flexible and rigid foams.

"Dimensional Stability of Thermoplastics," J. J. Scavuzzo and C. U. McNally, PLASTICS WORLD, 19, 3, 26 (March 1961).

Designer's guide for weatherability of nine selected materials.

"Modified Alkyd Moulding Compounds," J. J. Moylan and P. D. Sullivan, INDIAN PLASTICS, 12, pg. 15 (Dec. 1960).

Review of the unique combination of properties offered by these materials.

"Chemicals from Alcohol—An Assessment," R. K. Bhatnagar and N. R. Kuloor, INDIAN PLASTICS, 10, pg. 27 (Oct. 1960).

Review showing that there is still promise for alcohols in PVC.

"Modern Adhesives: Their Properties and Benefits," E. A. Heinrichs, INDIAN PLASTICS, 11, pg. 13 (Nov. 1960).

Review of newer adhesives.

"Carbide or Alcohol for PVC Resins," S. K. Dey, R. K. Bhatnagar, and N. R. Kuloor, INDIAN PLASTICS, 10, pg. 15 (Oct. 1960).

An account of the versatile properties of PVC.

"Ultraviolet Absorbers Mean New Life for Plastics," J. A. Weicksel, INDIAN PLASTICS, 10, pg. 12 (Oct. 1960).

Brief review on the use of U-V absorbers in vinyls.

"Organic Peroxides as Polymerization Initiators," J. W. Cywinski, APPLIED PLASTICS, 3, 10, 60; 3, 11, 56 (Oct. & Nov. 1960).

These first two parts of a four-part article discusses the chemistry and applications of organic perioxides and their use as catalysts for plastics.

"Glass-Fibre Reinforcement," J. Cooper, APPLIED PLASTICS, 3, 11, 63 (Nov. 1960).

A review of developments in this field since 1945.

"Determination of the Degree of Cure in Thermosetting Materials," H. Wiegand and H. Wallhaufer, KUNSTSTOFFE, 50, 11, 598 (Nov. 1960).

Conventional test methods fail when used to determine the degree of cure of moldings from which test specimens cannot be taken. The boiling test also does not give sufficient indications of degree of cure. Better results are obtained if the amount of soluble matter is determined, a comparison being made between this original amount and that in the finished molding.

"Glass-reinforced Molding Compounds," S. Rapizzi, POLIPLASTI, 8, 42, 41 (Sept.-Oct. 1960).

The author reviews the composition, preparation and types of compounds reinforced with chopped strand or rovings and discusses the problems in processing, molding and finishing. Applications in the electrical industry, in mechanicals, transportation, etc., are indicated. It is also noted that Italy is experimenting with glass reinforcement of polystyrene and nylon. (In Italian.)

"On Cellulose Triacetate as Raw Material for Varnishes and Plastics. The Possibility of Combining Cellulose Triacetate with Resins," K. Thinius and W. Thummler, PLASTE U. KAUTSCHUK, 7, 10, (Oct. 1960).

Investigations are described that show that while cellulose triacetate is compatible with a wider variety of natural and synthetic resins than are secondary acetate or acetobutyrate, its use imposes certain restrictions in the choice of solvents and plasticizers. However, with proper selection of extenders, skillful combination of esterification stage of the triacetate resins, and special plasticizers, it should be possible to utilize the good corrosion resistance of the triacetate, especially to organic liquids. (In German.)

"Behavior of Plastics in Re-Entry Environments," D. L. Schmidt, MODERN PLASTICS, 38, 3, 131; 38, 4, 147 (Nov. & Dec. 1960).

An analysis is given of re-entry behavior and ablation.

"Resistance of Plastics to Ethylene Oxide," Marshall Dick and C. E. Feazel, MODERN PLASTICS, 38, 3, 148 (Nov. 1960).

Test results are given for resistance of various plastics films to ethylene oxide.

"The Influence of Different Fillers on the Sound-Absorbing Properties of Accoustic Insulation Materials," H. Thurn, KUNSTSTOFEE, 50, 11, 606 (Nov. 1960).

Damping properties of accoustic insulation materials were determined at about 200 Hz as a function of the temperature, using a deflection oscillograph. Results showed that the effects of temperature and thickness of the filler were of primary importance.

"Developments in the Processing and Use of Glass Fiber Reinforced Plastics," M. Hagedorn, KUNSTSTOFFE, 50, 11, 613 (Nov. 1960).

The conclusion of a report on the 15th conference of the SPI Reinforced Plastics Division in 1960.

"New Developments in the Cross-Linking of Elastomers," R. Pariser, KUNSTSTOFFE, 50, 11, 623 (Nov. 1960).

An accurate, yet simple, method is given for measuring cross-link densities.

"Approaches to Making Plastics Flame Retardant," G. P. Mack, CHEM. PROCESSING, 23, 12, 27 (Dec. 1960).

A discussion of various additives for flame retardancy.

"Processing of Acetal Resins," P. N. Richardson, SPE J., 16, 12, 1324 (Dec. 1960).

How the calculation of melting and freezing rates helps in predicting processing behavior.

Equipment

"Heating Capacity Limitations of Extruder Screws," B. H. Maddock, SPE J., 17, 4, 368 (April 1961).

An ANTEC paper on extruder screw designs.

"Equipment for Embedment Processes," C. A. Harper, MODERN PLASTICS, 38, 8, 105 (April 1961).

Review of available systems for mixing, metering, and dispensing resins.

"The Present Status of Blow Molding," W. O. Bracken, PLASTICS WORLD, 19, 4, 34 (April 1961).

Brief observations on recent modifications in equipment.

"The Rotating Spreader—A Device for Superior Injection Molding," Neil Keiser, L. H. Cirker & P. D. Kohl, SPE J., 17, 4, 340 (April 1961).

Description of the spreader and its application for injection molding.

"How to Buy an Injection Molding Machine in 1961," W. G. Kriner, PROGRESSIVE PLASTICS, pg. 60 (March 1961).

Non-technical description of the three available styles.

"Aging of Plastics," M. Walter, PENSEZ PLASTIQUES, No. 87, pg. 86, (Sept. 1960).

After a critical discussion of natural and artificial aging methods and their results, and aging equipment in general, the author describes a four-chambered installation designed for testing under various conditions: heat to 200° C. cold; heat to —40° C.; exposure to ultra-violet and infra-red rays; and humidity 0 to 100%, saline mists, and destructive gases. (In French.)

"Economical Manufacture of Molds for Injection of Plastics," H. Lebre, PENSEZ PLASTIQUES, No. 87, pg. 79, (Sept. 1960).

Details are given on the production of plastics injection molds by casting an iron-zinc alloy (Kayem). Their advantages, as well as their limitations, for thermoplastics and thermoset materials are mentioned. (In French.)

"Automatic Conveyor for Polyethylene Granules," H. H. Boroughs, G. A. Quick, Jr., and J. F. Sheehan, Jr., RUBBER & PLASTICS AGE, 41, 12, 1508 (Dec. 1960).

Description of the Western Electric conveyor at the company's British plant.

"Hot Runner Molds," A. Ripley, RUBBER & PLASTICS AGE, 41, 12, 1502 (Dec. 1960).

Brief article on making and installing hot runner molds in injection machines.

"Development of Automatic Preplasticization," M. Lecat, PENSEZ PLASTIQUES, 7, 214-215, 13 (Oct. 1960).

The changes in design are described for obtaining automatic preplasticization on small capacity (30 grams and 60-85 grams) injection molding machines by utilizing the useful force of the return stroke of the injection ram. The system is said to be simpler and faster than screw plasticization, and has fewer parts subject to wear. (In French.)

Directory

1 time	$22.00 per inch
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FOR SALE

Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 oz. new and used, 2 to 10 head blow molding machines, Extruders, die lifts, temperature control units, weigh feeders and refrigeration systems.

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2-Late Model Baker hyd. self contained plastic or rubber transfer molding presses, 12x16" $3,250.00 each.

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6" D-S extruder with all controls, hoppers, and drives. Has approximately 500 hours running time.

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PLASTICS TECHNOLOGY
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CALENDAR of COMING EVENTS

June 16-25
Europlastic 61. International Plastics Exhibition. Palais des Floralies, Ghent, Belgium.

June 19-20
Plastics Institute. Education and Training in the Plastics Industry. Institution of Electrical Engineers, Savoy Place, London W.C. 2, England.

June 21-July 1
International Plastics Exhibition and Convention. Grand, National, & Empire Hall, Olympia, London.

June 25-30
ASTM Annual Meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

July 3-7
Gordon Research Conferences. Polymers. Colby Junior College, New London, N. H.

July 17-21
Gordon Research Conferences. Elastomers. Colby Junior College, New London, N. H.

July 18-20
Western Plant Maintenance & Engineering Show. Pan Pacific Auditorium, Los Angeles, Calif.

July 27-August 1
International Symposium on Macromolecular Chemistry. Queen Elizabeth Hotel, Montreal, Quebec, Canada.

September 3-8
American Chemical Society National Meeting. Chicago, Ill.

September 12
SPE Central Indiana Section RETEC. Plastics for Tooling. Hotel Severin, Indianapolis, Ind.

October 5
SPE Buffalo Section RETEC. Plastics Foams. Niagara Falls, N. Y.

October 12-13
SPI New England Section Conference. Wentworth-by-the-Sea, Portsmouth, N. H.

October 16-19
TAPPI Engineering Conference. Economic Solutions through Engineering. Shoreham Hotel, Washington, D. C.

October 17-19
Plastics Show of Canada. Automotive Building, Exhibition Park, Toronto, Canada.

October 25
SPE Kentuckiana Section RETEC. Plastics in Major Household Appliances. Louisville, Ky.

November 2-3
SPE North Texas Section RETEC. Plastics in Packaging and Engineering Exhibition. Sheraton-Dallas Hotel, Dallas, Tex.

November 15
SPE New York Section RETEC. Vinyl Plastics in the Household. Statler-Hilton Hotel, New York, N. Y.

November 26-December 1
ASME Winter Annual Meeting. Statler-Hilton Hotel, New York, N. Y.

December 1
SPE Cleveland Section RETEC. Plastics Screw Injection Molding. Cleveland Engineering Society Building, Cleveland, O.

December 5-7
Building Research Institute 1961 Fall Conferences, Shoreham Hotel, Washington, D. C.

Abstract of Important Articles (Cont'd.)

"Screw Injection Molding," P. Roesch, IND. PLASTIQUES MOD., 12, 10, 25 (Dec. 1960).

The author follows the evolution of the screw-injection machine, citing and briefly describing injectors with screw extrusion patented in Germany, Britain, France, Italy and America from 1927 onward. He compares advantages and disadvantages of screw and plunger-type injection machines and suggests not going too far with screw injection or trying to make a continuous extruding process of it. A relatively simple screw, he believes, will probably suffice for injection of all types of material. (In French.)

"Process and Equipment for Manufacturing Strong Reinforced Plastics Parts," R. H. A. Tenard, PENSEZ PLASTIQUES, 7, 221-222, 21 (Dec. 1960).

High mechanical resistance is claimed for reinforced plastics parts made by a recently patented process in which suitable reinforcing thread or strands are impregnated with plastics under vacuum; then the unwoven threads are distributed over a support and subjected to purely physical (but not direct) mechanical and tension tests. While the thread is under tension, the impregnation is made to harden. The equipment used is described separately. (In French.)

"The Performance of Single Screw Extruders in the Processing of Polyolefins and PVC—Conclusion," O. Schiedrum and H. Domininghaus, PLASTICS (LONDON), 26, 281, 81 (March 1961).

The second and concluding part of the paper on extruders.

Applications

"Application and Preparation of Polyester Resins for Bonding," K. H. Kussner, PLASTE U. KAUTSCHUK, 7, 9, 431 (Sept. 1960).

Cold-setting bonding materials for metals are prepared from various unsaturated polyester resins in which a redox system (dimethylaniline/benzoyl peroxide) promotes setting. Bond strength is increased by the addition of a dark, ground shale or metal powders. Accelerators may be omitted when metal powders are used. (In German.)

"Use of Allylic Derivatives as Optical Materials," R. Grandperret, IND. PLASTIQUES MOD., 12, 8, 41 (Oct. 1960).

Diethylene-glycol-bis-allyl carbonate satisfies requirements for optical materials. The preparation of the material, molding conditions and molds, polymerization and finishing are described as well as the properties of the lenses obtained. (In French.)

"Plastics Sacks," M. Parducci, MATERIE PLASTICHE, 26, 10, 960 (Oct. 1960).

Large sacks of PVC have recently been introduced in Italy for packing chemical fertilizer. It is explained why PVC, instead of polyethylene, is preferred for this purpose in Italy. There are still problems to be solved, but users are largely satisfied with the advantages the plastics sacks offer over conventional sacks for the purpose. (In Italian.)

"Epoxide Tools—An Appraisal" R. G B. Mitchell, PLASTICS (LONDON), 25, 275, 354 (Sept. 1960).

This application is shown to have promise

"Water Absorption of Unplasticized PVC," H. Uojlenburg, PLASTICS (LONDON), 25, 275, 359 (Sept. 1960).

Test results are given on water absorption.

Domestic Production and Sales of Plastics and Resin Material, January and February, 1961

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of January and February, 1961. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	January, 1961		February, 1961	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,237,764	1,269,281	1,416,922	1,318,821
Sheets, 0.003 gage and over	1,731,568	1,451,712	1,568,527	1,639,765
All other sheets, rods, and tubes (including other cellulose plastics)	764,683	746,279	723,071	746,182
Molding and extrusion materials (including other cellulose plastics)	6,652,054	5,794,788	6,305,311	6,483,068
Nitrocellulose sheets, rods, and tubes	88,515	93,434	72,555	89,408
TOTAL	10,474,584	9,355,494	10,086,386	10,277,244
Phenolic and Other Tar-Acid Resins:				
Molding materials	15,736,315	13,351,519	15,270,962	13,672,734
Bonding and adhesive resins for—				
Laminating (except plywood)	4,879,152	3,545,617	5,413,017	3,565,340
Coated and bonded abrasives	1,127,037	1,181,653	1,055,336	1,017,493
Friction materials (brake linings, clutch facings, and similar materials)	994,118	781,431	728,433	674,719
Thermal insulation (fiber glass, rock wool)	5,322,833	2,949,150	6,094,516	3,002,040
Plywood	4,889,036	4,081,074	4,648,186	3,905,954
All other bonding and adhesives uses	4,646,257	4,440,106	4,047,172	4,370,721
Protective-coating resins unmodified and modified except by rosin	1,665,289	1,282,527	1,341,449	1,175,124
Resins for all other uses	3,169,200	2,897,151	3,316,421	3,101,367
TOTAL	42,429,237	34,510,228	41,915,492	34,485,492
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,488,833	2,298,455	2,211,417	2,208,001
Paper-treating and paper-coating resins	1,870,422	1,898,445	1,886,103	1,874,993
Bonding and adhesive resins for—				
Laminating	2,030,681	2,276,730	2,071,633	1,844,321
Plywood	5,596,802	5,398,195	5,210,954	5,200,784
All other bonding and adhesive uses	3,214,983	3,367,998	3,152,953	3,141,191
Protective-coating resins, straight and modified	2,580,735	1,891,721	2,452,985	1,672,045
Resins for all other uses, including molding	8,785,621	8,689,321	7,854,379	8,544,739
TOTAL	26,568,077	25,910,865	24,840,424	24,486,074
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	21,352,371	17,291,020	19,490,726	17,838,775
All other	30,159,508	29,018,085	26,535,403	26,857,205
Protective-coatings	6,542,528	5,655,165	5,273,707	4,897,982
Textile and paper treating and coating resins	4,835,851	4,732,103	4,888,354	4,908,529
All other uses	10,156,778	17,277,377	11,770,093	17,689,477
TOTAL	73,047,036	73,973,750	67,958,283	72,191,968
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		7,310,648		7,145,170
Sheeting (resin content)		10,615,214		8,877,621
Molding and extrusion (resin content)		23,416,901		20,298,817
Textile and paper treating and coating (resin content)		5,149,518		4,384,624
Flooring (resin content)		12,866,225		12,602,727
Protective coating (resin content)		2,901,547		2,124,130
All other uses (resin content)		7,724,556		8,444,158
All other vinyl resins for—				
Adhesives (resin content)		4,501,434		5,063,504
Protective coatings (resin content)		2,082,338		2,133,287
All other uses (resin content)		9,869,655		8,802,685
TOTAL	87,690,532	86,438,036	81,148,835	79,876,723
Coumarone-Indene and Petroleum Polymer Resins	14,808,990	16,310,336	15,299,184	14,844,521
Polyester Resins:				
For reinforced plastics	8,019,843	8,588,672	10,535,619	9,481,872
For all other uses	1,579,443	1,380,602	1,531,769	1,511,557
TOTAL	9,599,286	9,969,274	12,067,388	10,993,429
Polyethylene Resins:				
For film and sheeting		40,559,500		37,384,225
Molding materials		14,319,676		14,905,468
Extrusion materials		14,376,506		10,965,139
For all other uses		38,358,107		45,014,322
TOTAL	114,481,696[1]	107,613,789[2]	108,308,903[3]	108,269,154[4]
Polypropylene Resins: TOTAL	5,040,387	3,807,860	5,206,235	4,185,596
Epoxy Resins:				
For protective coatings		1,883,615		1,731,732
For all other uses		2,302,366		2,617,044
TOTAL	4,775,295	4,185,981	4,461,280	4,348,776
Silicone Resins	434,391	443,358	654,623	518,598
Miscellaneous Synthetic Plastics and Resin Materials	21,360,903	19,515,345	20,720,180	18,459,332
GRAND TOTALS	410,710,414	392,034,316	392,667,213	382,936,907

[1] 18.8% produced by the low-pressure process.
[2] 15.9% produced by the low-pressure process.
[3] 16.9% produced by the low-pressure process.
[4] 13.2% produced by the low-pressure process.
SOURCE: United States Tariff Commission, Chemical Division.

Current Market Prices

Prices in general are f.o.b. works. Ranges indicates variations in grade, quality, quantities, and geographical locations of customers. No guarantee of these prices is made, and spot prices should be obtained by contacting this publication.

Adhesives

Chloroprene type	gal.	$1.50 / $1.60
Epoxy type	lb.	1.33 / 2.00
Silicone type	lb.	1.64 / 10.80
Thiocyanate type	lb.	.1725/ .20

Catalysts

Ammonium thiocyanate	lb	.1725/ .26
Peroxide, acetyl, 25% in DMP	lb.	1.75 / 4.00
Benzoyl, dry, 96%	lb.	.88 / 2.00
Wet, 50% paste in TCP	lb.	.89 / 2.25
In silicone fluid	lb.	2.75 / 4.25
In BBP	lb.	3.00 / 4.25
Caprylyl, liquid, 50% in mineral oil	lb.	4.45 / 5.00
In DOP	lb.	5.00
Cyclohexanone, 45% paste in DBP	lb.	3.00 / 4.00
Powder, 85%, in DBP	lb.	2.00 / 3.00
p-Cyclobenzoyl, paste, 50%		
In mineral oil	lb.	4.25 / 5.00
In TCP	lb.	5.00
2,4-Dichlorobenzoyl, 50%		
In silicone oil	lb.	4.25 / 5.00
40% in silicone oil	lb.	5.00
Di-t-butyl	lb.	2.00 / 4.00
Other peroxides	lb.	2.05 / 5.00

Colorants

Black, std.	lb.	.90 / 4.10
Gel coats	lb.	.61 / .86
Carbon black	lb.	.0575/ .87
Paste	lb.	.65 / .74
Bone blacks	lb.	.175 / .2775
Iron oxide	lb.	.15 / .23
Lampblack	lb.	.1225/ .175
Masterbatch	lb.	.60 / .63
Paste (for epoxies)	lb.	1.58 / 2.15
(for vinyls)	lb.	.50 / .66
Paste dispersion	lb.	.85 / 1.90
Paste concentrate	lb.	.82 / 1.20
Pigment dispersion	lb.	.83 / 1.15
Colloidal dispersions	lb.	.66 / 1 45
Aqueous	lb.	.115 / .395
Blue, std.	lb.	.90 / 2.75
Concentrate	lb.	.95 / 3.00
Masterbatch	lb.	.85 / 1.13
Pearl	lb.	1.38
Metallic	lb.	.02
Paste (for epoxies)	lb.	1.25 / 2.60
(for vinyls)	lb.	.62 / 1.84
Paste dispersion	lb.	.85 / 2.40
Paste concentrate	lb.	.78 / .80
Phosporescent	lb.	.24
Brown, std.	lb.	.87 / 4.00
Copper tinsel	lb.	.10
Gel coats	lb.	.59 / 1.04
Iron oxide	lb.	.15 / .24
Metallic bronze	lb.	.02
Paste (for epoxies)	lb.	1.18 / 1.47
(for vinyls)	lb.	.48 / 1.67
Paste dispersions	lb.	.75 / 1.70
Paste concentrate	lb.	.65 / 2.30
Gold, metallic	lb.	.21
Paste dispersions	lb.	1.40 / 1.60
Tinsels	lb.	.10
Gray, gel coat	lb.	.59 / .84
Paste (for epoxies)	lb.	1 40
Paste dispersion	lb.	1 45 / 2.20
Green, std.	lb.	90 / 3.25
Pearl	lb.	10
Concentrate	lb.	95 / 3.00
Metallic	lb.	21
Phosphorescent	lb.	.24
Masterbatch	lb.	1.20 / 1.23
Paste (for epoxies)	lb.	2.86
(for vinyls)	lb.	.80 / 1.83
Paste dispersions	lb.	.85 / 2.70
Paste concentrate	lb.	.80 / 2.15
Chromic oxide	lb.	.45 / 1.40
Orange, dry	lb.	.49 / 3.50
Gel coat	lb.	.75 / 1.05
Lithopone	lb.	1.63 / 1.86
Paste (for epoxies)	lb.	1.58
(for vinyls)	lb.	.74 / 4.27
Paste dispersion	lb.	.55 / 2.80
Paste concentrate	lb.	1.58
Purple, pearl	lb.	.10
Red, std.	lb.	.1425/ 5.00
Cadium lithopone	lb.	1.90 / 2.86
Selenide	lb.	4.60 / 7.15
Concentrate	lb.	2.25 / 2.50
Iron oxide	lb.	.0475/ .205
Metallic	lb.	.021
Masterbatch	lb.	.75 / .88
Paste (for epoxies)	lb.	2.35 / 3.77
(for vinyls)	lb.	1.20 / 3.82
Paste dispersions	lb.	$0.90 / $3.05
Paste concentrate	lb.	5.42 / 6.49
Venetian	lb.	.065 / .1325
Silver, metallic	lb.	.0165
Paste (for epoxies)	lb.	1.55
(for vinyls)	lb.	.89 / .91
Paste dispersion	lb.	.85 / 1.45
Paste concentrate	lb.	1.02
Tinsels	lb.	.10
Yellow, std.	lb.	.12 / 3.50
Cadium lithopone	lb.	1.21 / 1.29
Gel coat	lb.	.61 / 1.03
Masterbatch	lb.	.90 / .93
Concentrate	lb.	1.00 / 2.50
Iron oxide	lb.	.1225/ .1875
Paste (for epoxies)	lb.	2.15 / 2.55
(for vinyls)	lb.	.58 / 3.70
Paste dispersions	lb.	.90 / 2.20
Paste concentrate	lb.	.65 / 2.87
White, std.	lb.	.54 / 4.00
Concentrate	lb.	.70 / 1.25
Gel coat	lb.	.59 / .84
Masterbatch	lb.	.75 / .80
Paste (for epoxies)	lb.	1.02
(for vinyls)	lb.	.48 / .60
Pearl	lb.	.10
Paste dispersion	lb.	.70 / 2.00
Paste concentrate	lb.	.705 / .725

Fillers

Aluminum silicate pigments	ton	21.50 / 65.00
Barytes	ton	60.00 / 123.00
Paste concentrate	lb.	.705 / .725
Calcium carbonate, ppt	ton	30.00 / 187.00
Std.	ton	15.00 / 35.00
China clay	ton	40.00
Flours	ton	50.00 / 106.00
Flocks, cotton	lb.	.12 / .30
Rayon	lb.	.50 / 1.25
Nylon	lb.	.35 / 2.75
Mica	lb.	.075 / 4.44
Silica	ton	25.00 / 48.50
Whiting	ton	8.75 / 13.25
Oster shell	lb.	30.00
Wollastonite	ton	29.00 / 47.50

Miscellaneous

Anti-Fog	gal.	8.69 / 16.95
Anti-Static	gal.	3.57 / 8.50
(for films)	gal.	8.00 / 8.50
Purging cmpd. (for injection)	lb.	.40
Wetting agent (for dry coloring)	gal.	2.50 / 3.20
(for wet operations)	lb.	2.59 / 3.69

Mold Release Agents

Silicone type: Cmpds	lb.	4.70 / 5.20
Emulsions	lb.	1.09 / 1.65
Fluids	lb.	2.74 / 6.00
Solvent emulsions	lb.	.40 / 4.95
Stearates: Barium	lb.	.41 / .46
Calcium	lb.	.39 / .44
Magnesium	lb.	.42 / .47
Zinc	lb.	.41 / .48

Plasticizers

Adipate, Butyl Cellosolve	lb.	.45 / .47
Didecyl	lb.	.265 / .375
Dibutoxyethyl	lb.	.425 / .46
Diisodecyl	lb.	.40 / .44
Diisobutyl	lb.	.41 / .44
Dioctyl	lb.	.36 / .535
Diisooctyl	lb.	.36 / .435
2-ethyl hexyl	lb.	.36 / .435
Isooctylisodecyl	lb.	.40 / .435
Isooctyl	lb.	.49 / .535
n-Octyl decyl	lb.	.36 / .44
Azelate, dioctyl	lb.	.445 / .49
Di-2-ethyl hexyl	lb.	.455 .505
Epoxy, polymeric	lb.	.3225/ .3525
Monomeric	lb.	.3475/ .3775
Ester, Fatty Acid	lb.	.3525/ .3775
Monomeric	lb.	.35 / .60
Laurate, Butoxyethyl	lb.	.39 / .40
Oleate, Butyl	lb.	.24 / .33
Butoxyethyl	lb.	.30 / .33
Methoxyethyl	lb.	.31 / .34
Phosphate, Tributyl	lb.	.50 / .535
Tricresyl	lb.	.325 / .36
Phthalate, Butyl Cellosolve	lb.	.35 / .385
Butyl octyl	lb.	.255 / .30
Cyclohexyl	lb.	.265 / .305
Isodecyl	lb.	.26 / .30
Butoxyethyl	lb.	$0.365 / $0.375
Dibutyl	lb.	.2[illegible] / .43
Dicapryl	lb.	.2[illegible] / .445
Dicyclohexyl	lb.	.48 / .595
Didecyl	lb.	.27
Diisodecyl	lb.	.25 / .45
Diisooctyl	lb.	.26 / .445
Dioctyl	lb.	.245 / .305
Isooctyldecyl	lb.	.27 / .45
Methoxyethyl	lb.	.355 / .405
Polyester type	lb.	.385 / .7125
Polymeric type	lb.	.39 / .93
High-solvating	lb.	.37 / .425
Ricinoleate type	lb.	.32 / .35
Sebacate, Dibenzyl	lb.	.91 / 1.04
Dibutyl	lb.	.655 / .745
Dioctyl	lb.	.5925/ .6825
Soy Bean oil, epoxized	lb.	.3235/ .4775
Stearate, Butyl	lb.	.235 / .295
Butoxyethyl	lb	.31 / .32
Epoxized octyl	lb	.3475/ .5325
Methoxyethyl	lb.	.32 / .35
Octyl epoxy	lb	.3925/ .447
Tallate, Octyl epoxy	lb.	.3475/ 4.025

Resins, Molding, Casting & Coating

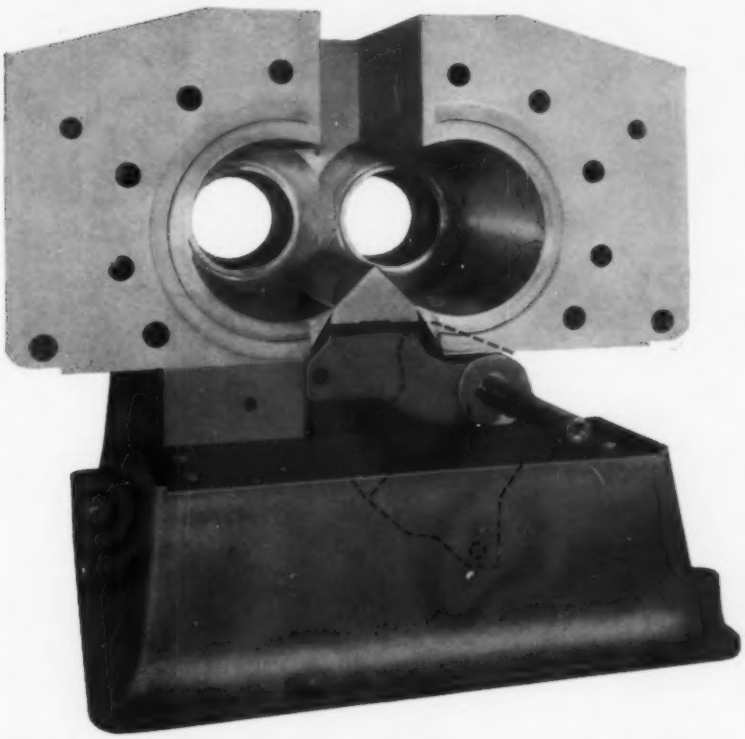
ABS type	lb.	.44 / 1.05
Acetal	lb.	.65 / .93
Colors	lb.	.74 / 1.24
Acrylic	lb.	.46 / 1.08
Alkyd	lb.	.1325/ 1.20
Allyl (diallyl phthalate)	lb.	.95 / 2.50
Carbonate	lb.	1.30 / 2.25
Cellulosics:		
Cellulose acetate	lb.	.35 / .68
Reprocessed	lb.	.25 / .36
Cellulose acetate-butyrate	lb.	.40 / .81
Reprocessed	lb.	.35 / .45
Cellulose propionate	lb.	.40 / .81
Ethyl cellulose	lb.	.67
Reprocessed	lb.	.30
Epoxy, liquid	lb.	.60 / 1.41
Solid	lb.	.51 / 1.31
Fluorocarbons	lb.	3.25 / 11.00
Furane	lb.	.75 / 1.00
Liquid	lb.	.32 / .44
Melamine	lb.	.57 / .70
Coating solns	lb.	.3275/ .4375
Phenolic	lb.	.207 / 1.12
Coating solns	lb.	.305 / .3525
Polyamide	lb.	.62 / 1.26
Coatings	lb.	.61 / 1.51
Graphite-filled	lb.	1.40 / 1.83
Heat-stabilized	lb.	1.09 / 1.55
Molybdenum sulfide-filled	lb.	1.19 / 2.07
Polycarbonate	lb.	1.30 / 2.29
Polyester, powder	lb.	.26 / 2.20
Coating	lb.	.0975/ .1275
Glass-reinforced	lb.	.41 / .80
Polyethylene, low-density	lb.	.2375/ .615
Medium-density	lb.	.2375/ .6425
High-density	lb.	.275 / 1.59
Polypropylene	lb.	.42 / 1.17
Reprocessed	lb.	.50
Polystyrene	lb.	.18 / 1.34
Reprocessed	lb.	.15 / .26
Rubber-modified	lb.	.20 / .275
Polyurethane	lb.	1.30 / 7.50
Silicones, casting	lb.	7.50 / 11.40
Molding	lb.	2.40 / 3.55
Urea coating solns	lb.	.205 / .27
Vinyl, dispersion grade	lb.	.24 / .325
Copolymers	lb.	.2025/ .44
Molding	lb.	.185 / .66
Nitrile rubber blend	lb.	.45 / .53
Reprocessed	lb.	.19 / .22
Vinyl-vinylidene copolymer	lb.	.185 / .32
Vinylidene	lb.	.205 / 6.00
Latex	lb.	.45 / .52

Solvents

Ketones: Acetate	lb.	.08 / .22
Methyl isoamyl	lb.	.175 / .315
Esters: Ethyl acetate	lb.	.125 / .2675
Isopropyl acetate	lb.	.115 / .255
n-Butyl acetate	lb.	.145 / .285
Alcohols: Isobutyl	lb.	.13 / .27
n-Butyl	lb.	.155 / .295

Stabilizers

Alkyd tin mercaptide, liquid	lb.	2.50 / 3.15
Barium-cadmium complex, liquid	lb.	.50 / .585
Solid	lb.	.97 / 1.25
Barium-cadmium laurate	lb.	.87 / .90
Myristate	lb.	.72 / .75
Barium-cadmium-zinc complex	lb.	.54 / .56
Barium-zinc, liquid	lb.	.58 / .615
Powder	lb.	.375 / .44
Complex	lb.	.47 / .50
Cadmium-barium, powder	lb.	.68 / .895
Chelating agent, liquid	lb.	.57 / .84
Cadmium-containing	lb.	.84 / .87
Zinc-containing	lb.	.62 / .80
Organic complex, liquid	lb.	.57 / .845
Strontium-zinc laurate	lb.	.72 / .75
Zinc, liquid	lb.	.48 / .52



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Left: Size 9D Banbury with spray-cooled sides for most efficient cooling can also be used with up to 15 pounds of steam for moderate heating.

Right: Size 3D Banbury with cored sides, recommended for use where high machine temperatures are necessary.

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